Railway Age Gazette

DAILY EDITION

Copyright, 1914, by the Simmons-Boardman Publishing Co.

Vol. 56. CHICAGO—MARCH 20, 1914—NEW YORK No. 11d.

PUBLISHED DAILY BY

Simmons-Boardman Publishing Co., Transportation Bldg., Chicago, Ill., on the occasion of the annual convention of the American Railway Engineering Association and the stated meeting of the Railway Signal Association.

NEW YORK: Woolworth Bldg. CLEVELAND: Citizens Bldg.
LONDON: Queen Anne's Chambers, Westminster.

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Subscriptions, including 52 regular weekly issues and special daily editions published from time to time in New York, or in places other than New York, payable in advance and postage free:

United States and Mexico.....$5.00
Canada 6.00
Foreign Countries (excepting daily editions)..... 8.00
Single Copies.....15 cents each

Engineering and Maintenance of Way Edition and the four Maintenance of Way Convention Daily issues, North America, $1.00; foreign (excepting daily editions), $2.00.

Application made at the Post Office at Chicago, Ill., for entry as mail matter of the second class.

WE GUARANTEE, that of this issue 10,500 copies were printed; that of those 10,500 copies, 9,759 copies were mailed or delivered by messenger to regular paid subscribers; 445 copies were distributed among members and guests of the American Railway Engineering Association and at the Coliseum; 146 copies were mailed to advertisers; and 150 copies were set aside for office use.

Contents

EDITORIAL:

Editorial Notes 705
Uniform Crossing Signs..... 706

PROCEEDINGS:

American Railway Engineering Association..... 707

MISCELLANEOUS:

Announcements 706

Service Results of Screw Spikes

While not entirely pertinent to the report presented by the committee, the discussion of screw spikes yesterday morning brought out much valuable and instructive information. The relative advantages of screw and cut spikes have been the subject of spirited controversy for several years, and the installation of screw spikes has met with considerable opposition. Several roads, however, have made extensive tests, and the results of these experiments, as related by G. J. Ray, W. B. Storey and Robert Trimble are of definite value. As brought out in the discussion, the resistance of the screw spike to lateral thrust is of equal importance with its resistance to vertical displacement, and this phase is receiving increased attention in tests made in the last two years. It is universally admitted that the screw spike offers much greater resistance to vertical displacement. Mr. Ray's statement that the resistance to lateral thrust was shown by recent experiments to be over twice that of the cut spike is also instructive. As suggested by Mr. Storey, the problem is largely one of ultimate economy in maintenance. Screw-spike construction costs more initially, and this increased cost is more readily justified on lines of heavy traffic, where the normal maintenance expense is relatively high, as on the Lackawanna, than on lines carrying lighter traffic, as on some portions of the Santa Fe. While the use of screw spikes to any considerable extent has been limited to the past few years and no entirely conclusive results can be cited, the service so far strongly indicates their practicability and the problem is only one of economy. The advantage of screw spikes, therefore, increases as the density of traffic increases on the different lines throughout the country.

A. R. E. A. in the Lead

The adoption of the standard conventional signs of the American Railway Engineering Association in the specifications for maps and profiles, prescribed by the Interstate Commerce Commission in connection with the federal valuation of railways, is a definite example of the recognition which the work of this association is receiving. In many cases it is necessary for the committees to make their recommendations accord with previous standards, but whenever possible, it should be the aim to establish standard practice, as no organization is so well fitted to take the lead in problems relating to engineering and maintenance work on American railways.

A New Investigation

It is rumored that a new and thorough investigation, under the Sherman anti-trust law, will be inaugurated on the Santa Fe. Vice-president W. B. Storey is now president of the American Railway Engineering Association. George E. Rex, superintendent of timber-treating plants, is president of the American Wood Preservers' Association. T. S. Stevens, signal engineer, is now vice-president of the Railway Signal Association and will probably be elected president of this association at the annual meeting next October. It is feared that the concentration of the presidencies of three of the five important railway engineering associations on the Santa Fe is an illegal monopoly, which the authorities may attempt to break up.

This Year's Successful Exhibit

The general opinion among exhibitors at the Coliseum seems to be that this year's show is the most successful that was ever conducted. In spite of the quiet condition in the railroad supply business, a number of leading concerns report that the interest taken in the exhibits has been unusually keen. Not the least encouraging feature of the exhibit to those who are spending their money and time to bring the latest developments in railway supplies to the attention of operating officers is the unusually large number of high officers who are visiting the show. One man whose long connection with the railroad supply business makes him deserving of being classed among the "oldest inhabitants," says that he never saw so many railroad presidents, vice-presidents, general managers and general superintendents all together in one week as he has this year at the Coliseum.

Reciprocity with Canada

The appointment of L. C. Fritch as assistant to the president of the Canadian Northern, announced in Tuesday's Daily edition, emphasizes the extent to which railway officers of the United States have been called to important executive positions on the Canadian railways. Sir William C. Van Horne, former president of the Canadian Pacific, gained his early training on the Illinois Central. Sir Thomas Shaughnessy, president of the Canadian Pacific, is a native of Milwaukee and received his early experience on the Chicago, Milwaukee & St. Paul. The late Charles M. Hayes, former president of the Grand Trunk, was president of the Southern Pacific. E. J. Chamberlin,

president of the Grand Trunk, was born in New Hampshire, and was for a number of years on the Central Vermont Railroad. Howard G. Kelley, vice-president of the Grand Trunk, was formerly chief engineer of the Minneapolis & St. Louis. H. R. Safford, chief engineer of the Grand Trunk, received his early training on the Illinois Central. This exchange, however, is not entirely one-sided. James J. Hill, the leading figure in the railroad world of America, is a Canadian by birth, and W. C. Cushing, chief engineer maintenance of way, Southwest system, Pennsylvania Lines, and other prominent railway officers are also natives of Canada.

Uniform Crossing Signs

While the subject of crossing signs is of secondary importance, it is one of those details of railway operation which are of considerable consequence in the aggregate. With the agitation for the elimination of grade crossings and the demands by public authorities for continually increasing expenditures for this purpose, the adoption of any effective means to lessen the danger of accidents at grade crossings should be encouraged. The adoption of uniform crossing signs is one means to this end. The wide divergence in the character of these signs on different railroads in the same vicinity leads to confusion, and thereby to danger on the part of the traveling public. State railway commissions are recognizing the fact, and in a number of instances have adopted standard signs, which the railways must construct. The lack of uniformity in the requirements of the commissions also imposes added and unnecessary expense on the railways. A road passing through a number of states is now, or eventually will be, required to have a number of different standard signs conforming with the regulations in the different states unless present tendencies are checked. As the purpose of a sign is the same in all states, a uniform sign should be entirely practical. The universal adoption of such a sign will eliminate confusion on the part of the traveling public and will decrease the expense to the railways. It was stated on the floor of the convention yesterday morning that the National Association of Railroad Commissioners is considering this subject. It was evident from the discussion that the members realized the advantages that would be derived from a uniform sign and favored the adoption of one by the Association, indicating that the signs adopted would meet with ready acceptance by the roads. The various utility commissions undoubtedly would then fall into line and co-operate with the Association.

MEETING OF RAILWAY BUSINESS ASSOCIATION DIRECTORS

A meeting of the directors of the Railway Business Association was held in Chicago this week. George A. Post, the president, and Frank W. Noxon, the secretary of the Association, attended some of the sessions of the convention while here.

A HISTORIC GAVEL

In his closing remarks as president, Mr. Wendt called attention to the fact that the gavel which he held is fast becoming a relic, as this same gavel has been used by the presiding officer at every one of the fifteen conventions of the association.

A COMPLETE ROCK ISLAND PARTY

The entire engineering and maintenance staff of the Kansas division of the Chicago, Rock Island & Pacific was in attendance at the convention and track supply exhibit on Wednesday and Thursday. The superintendent, A. B. Ramsdell, headed the delegation, which included L. J. Hughes, division engineer; F. L. Park, master carpenter; Charles Hattery, signal supervisor; J. G. Hutchinson; William Broddle and N. T. Blackwell, roadmasters. The party returned last night by way of Des Moines, Ia., and the new Kansas City Short Line, in order to give the men an opportunity to see this new Rock Island connection.

NEW CONSTRUCTION PROPOSED

The Gulf, Florida & Alabama expects to ask for bids soon for a 750-foot bridge over the Alabama River. J. T. McCarthy & Co., Gainesville, Fla., has a contract for grading from Broughton, Ala., to Pinehill.

E. W. McKENNA TO INVESTIGATE ROCK ISLAND

E. W. McKenna, vice-president of the Chicago, Milwaukee & St. Paul, has been retained by a bondholders' protective committee to make an investigation and report on the property of the Chicago, Rock Island & Pacific.

A CORRECTION

In describing the large amount of construction work done by the Chicago, Milwaukee & St. Paul during the past two years, in yesterday morning's daily edition, the statement that 15,682 lbs. of reinforcing steel had been used should have read 15,682,000. The work of these two years was concentrated mainly in the construction of a new line from Lewiston, Mont., northwest 135 miles to Great Falls, and in the construction of second track from Green Island, Ia., to Coon Rapids, 150 miles, and from Minneapolis, Minn., west to Aberdeen, S. D., 290 miles. In these two years 48,303,611 cu. yds. of earth work was moved and 563,812 cu. yds. of concrete was placed. This is a most unusual record and emphasizes the magnitude of the work occasionally handled by railway organizations.

THE ASSOCIATION'S RESOLUTIONS

The following resolutions were adopted at the closing meeting of the convention yesterday afternoon:

"Resolved, by the members of the American Railway Engineering Association, in convention assembled, that we desire and hereby do give an expression of appreciation of the able manner in which the retiring president, Edwin F. Wendt, has discharged the duties of president during the past year and presided over the meetings of this convention; that this resolution be spread upon the minutes and a copy be engraved and presented to Mr. Wendt.

"Resolved, by the members of the American Railway Engineering Association, in convention assembled, that we desire to place on record our appreciation and extend our hearty thanks to—

"Hon. Charles A. Prouty, Hon. Charles Marcil and Col. J. M. Schoonmaker for their admirable and instructive addresses at the annual dinner; to the National Railway Appliances Association for the instructive and comprehensive exhibit of devices used in the construction, maintenance and operation of railways; to the technical press for the daily reports of the convention and the useful information made available to the members; to the official reporters, Messrs. T. E. Crossman and G. W. Burgoyne, for their accurate and painstaking reports of this and previous conventions; to the tellers, Messrs. Frink, Bergen, Gordon, Nelson, Wilgus and Dorrance, for their arduous labors in counting and tabulating the ballots for officers for the ensuing year; to committee No. '23,' on arrangements, for the highly successful arrangements made for the comfort and entertainment of the members and guests attending this convention, and it is recommended that the Board of Direction grant the Committee a horizontal increase in its 'salary.'"

Proceedings of American Railway Engineering Association

Abstracts of Seven Reports Including Ties; Signs, Fences and Crossings; Conservation; Records and Accounts and Ballast

The Thursday morning session of the American Railway Engineering Association began at 9:30 a. m. with President Wendt in the chair The reports of the regular committees on Ties; Signs, Fences and Crossings; Conservation of Natural Resources; Economics of Railway Location; Records and Accounts, and Ballast, and of the special committee on Uniform General Contract Forms, were presented. Abstracts of these reports with the discussions are given below.

A recess was taken from 1 to 2 p. m. and the convention adjourned at 3:20. Just before the end of the final session, President-elect Storey, was installed and spoke briefly in accepting the position. The other features of closing business are mentioned elsewhere in this issue.

TIES

The following subjects were assigned:

(1) Report on the effect of design of tie plates and spikes on the durability of ties.

(2) Continue study of stresses to which cross-ties are subject, and determine size required.

L. A. DOWNS,
Chairman Committee on Ties.

(3) Report on economy in labor and material effected through the use of treated ties as compared with untreated.

(4) Continue to compile information as to the use of metal, composite and concrete ties.

THE EFFECT OF DESIGN OF TIE PLATES AND SPIKES ON THE DURABILITY OF TIES.

The committee reports progress on this subject and submits a partial report. There were 37 inquiries sent out to the principal railroads in the United States, from which there were 29 replies received, 27 of which agree to the following ideas:

(a) Plates with deep ribs or claws cut the tie so as to admit moisture and decay. The deep ribs or claws are not necessary to hold the plate in position and are undesirable.

(b) Flat-bottom plates used with cut spikes become loose and the looseness results in mechanical wear of the tie. They are satisfactory when used with screw spikes.

(c) Plates with cross-ribs not over 3-16 in. deep or other independent fastenings that will hold them to the tie, do not seriously damage the tie and at the same time do not become loose and cause mechanical wear when used with ordinary cut spikes.

(d) The width of the tie plate is an element to determine the mechanical wear of the tie. Those less than 7 in. wide, for use with softwood ties, cut into the tie sufficiently in some cases to determine their life.

(e) The plates should be of sufficient thickness to avoid cupping on either side of rail. This thickness depends on the projection beyond the rail, the amount of traffic, the kind of tie and the rate of deterioration from rust, etc.

(f) Screw spikes prolong the life of ties over that obtained with cut spikes.

(g) Where treated ties are used, all boring should preferably be done previous to treatment.

(h) Ordinary driven cut spikes, by breaking down the structure of the wood for an inch or so around the spike, facilitate decay at that poinnt where greatest strength of the tie is required. In the case of treated ties, this introduction of decay below the treatment may defeat the purpose of treatment.

(i) The breaking down of the structure of the wood, with the use of cut spikes, is, to a considerable extent, avoided where the spike is driven in a bored hole. Spikes so driven have at least the same holding power as spikes driven without boring. Where spike holes are to be bored and cut spikes used, the diamond-pointed cut spike is preferable, because of the greater ease with which it follows the hole.

ECONOMY IN LABOR AND MATERIAL EFFECTED THROUGH THE USE OF TREATED TIES COMPARED WITH UNTREATED TIES.

The comparative life and cost of untreated and treated cross-ties involve many variable factors. Few American railways have used treated ties long enough to obtain complete data on length of life, while records of life of untreated ties are not all reliable. The service life of ties depends on conditions under which the timber is grown and manufactured as well as the conditions to which the tie is subjected in the track.

The species of timber, the portion of the tree from which the tie is cut, the season of the year when cut, the extent of curing, the method of laying in track, the excellence of roadbed and ballast, the drainage, tie plates, rail base, splice, axleload, density of traffic and maintenance, all have their individual effects. Treated ties are further affected by the method and kind of treatment, variations in receptive qualities of different ties of the same kind of timber, and even of individual ties from the same tree.

Climatic conditions exert a powerful influence on tie-life, both before and after cutting and before and after putting in track. The northern latitudes, where seasons of plant growth are short, winters long, and altitudes high, make possible quite different results from those obtained in southern countries of low altitude and excessive humidity.

Cost and Life Tables.

Information received from 16 principal railways of the United States indicate actual average costs of tie treatment to 1913 as follows:

Ry. Co.	Creosote Company Plant.	Creosote Contract.	Zinc Chloride Company Plant.	Zinc Chloride Contract.	Card Process Company Plant.
1	.283	....	....	....	....
2	.258	....	....	....	....
3	....	.310	....	....	....
4	.250	....	....	....	....
5	....	.324	....	....	....
6	.380	....	....	....	....
7	.235	....	....	....	....
8	....	.235	....	....	....
9	.252	....	....	....	....
10	....	....	.112	....	....
11	....	....	....	.155	....
12	....	....	....	.150	....
13	....	....	.100	....	....
14	....	....	.100	....	....
15	....	....	....	....	....
16	....	....	....	....	.176
Averages	.276	.289	.104	.152	.176

The above costs include all labor, material, fuel, handling of ties at plant and charges for interest and depreciation in the case of company plants. In obtaining the following figures, no reports were considered where less than

40 per cent. of the original number had been renewed. To extend the figures beyond the percentage reported renewed, it was assumed that for the remaining percentage the renewals per year were equal to the average renewals for the years reported.

AVERAGE LIFE OF UNTREATED CROSS-TIES.

Deduced from "Statistics of Cross-Ties," p. 360, Vol. 12, Proceedings, A. R. E. A.

Railroad	Kind of ties	Number	State	Year laid	Percentage reported renewed and life	Computed Average Life of 100%
C. I. & S.	Red and White Oak	55,500	Illinois	1899	55.3 at 10 yrs.	9.7 yrs.
C. M. & St. P.	Yellow Pine	7,500	Iowa	1900	41.8 at 10 "	11.1 "
C. R. I. & P.	White Oak	101,700	Texas	1903	92.9 at 7 "	6.1 "
D. & I. R.	Tamarack	7,500	Minnesota	1902	73.6 at 8 "	7.8 "
Erie	Oak	8,605	Ohio	1903	45.9 at 7 "	7.5 "
Ill. Cent.	White Oak	351,600	Iowa	1899	49.5 at 11 "	11.2 "
L. S. & I.	White Oak	57,000	Michigan	1896	99.7 at 14 "	10.7 "
L. & A.	White and Post Oak	93,900	Louisiana	1903	55.3 at 7 "	7.1 "
L. & N.	White Oak	24,920	Kentucky	1895	100.0 at 13 "	9.5 "
M. H. & L.	Cypress, R. & W. Oak	236,160	Arkansas	1905	69.9 at 5 "	4.3 "
M. & O.	Oak	646,631	Miss. and Ala.	1897	74.7 at 13 "	10.6 "
M. & O.	Pine	646,631	Miss. and Ala.	1897	56.5 at 13 "	12 "
N. Y. C. & H. R.	White, Rock and Red Oak and Chestnut	150,048	Penn.	1901 2	100.0 at 8 "	5.9 "
P. & R.	White Oak	16,915	Penn.	1901	93.8 at 9 "	7.5 "
P. & R.	Oak and Chestnut	5,760	Penn.	1897	91.5 at 13 "	11 "
P. & R.	Chestnut	2,816	Penn.	1903	83.5 at 7 "	6.4 "
Penn. Lines West	White Oak	127,902	Ohio	1892	100.0 at 14 "	10 "
Average Life	8.7 yrs.					
White Oak only	9.1 yrs.					

The growing conservatism of engineers on the subject of the life of untreated ties is noted in answers to inquiries along this line made in 1913 as compared with answers from the same men in 1911, from which the above averages were deduced.

The annual cost of tie maintenance for labor and material is the governing consideration of the railway tie problem. Any change in the prevailing practice must stand the test of monetary economy. In a general consideration the increased cost of a treated tie is justified when the annual cost of its maintenance in track does not exceed the annual charge of the untreated tie. The increased life of a treated tie naturally decreases the number of annual renewals, resulting in a decreased labor charge and disturbance to the track and ballast.

The increased initial cost of a treated tie over an untreated tie raises the question of interest charges on the additional expenditure for the period of its life in track; and it is fair to assume that the ultimate economy of treated ties use must cover this interest feature. Numerout methods have been suggested for computing the resultant economy of trated ties over untreated ties, arriving at capitalized values or annual costs per tie. The accuracy of the monetary values arrived at may be questionable; but the results from a comparative standpoint have a direct workable value.

COMPARISONS OF COST AND LIFE OF TREATED AND UNTREATED TIES.

The tabulated results of 90 answers from members of this Association representing 230,000 miles of railway in the United States, Canada and Mexico to inquiries from the committee as to the comparative cost and life of treated and untreated cross-ties, indicate that the average life of untreated ties is 7.78 years; average cost, $0.761; the average life of treated ties is 13.85 years; average cost, $1.031. Information has also been obtained indicating that the average cost of removing an old tie and installing a new tie is about $0.23.

There is an undetermined factor of cost incidental to tie changing due to the disturbance of ballast and consequently of the surface of the track. Whatever this cost may prove to be, it is in inverse ratio to the life of the tie, and therefore least in the tie of the longest life. There seems no doubt that this cost is considerable and deserving of investigation, and further consideration will be given it.

So far as the committee's investigation has proceeded, the comparison of the cost in labor and material of the use of treated and untreated ties favors the tie which is treated with a preservative of such quantity and quality as to preserve the wood fiber against decay to the limit of mechanical wear. Among considerations favoring the use of treated ties may be mentioned: the rapid and alarming disappearance of the available supply of timbers suitable for use as untreaterd ties; the possibility of using available supplies of cheaper and so-called inferior timbers when chemically treated; the decrease in cost over a term of years of total tie renewals, owing to the reduced number of necessary tie renewals, and of reduced cost of the labor of surfacing, tamping and replacing of ties, fastenings and ballast resulting therefrom.

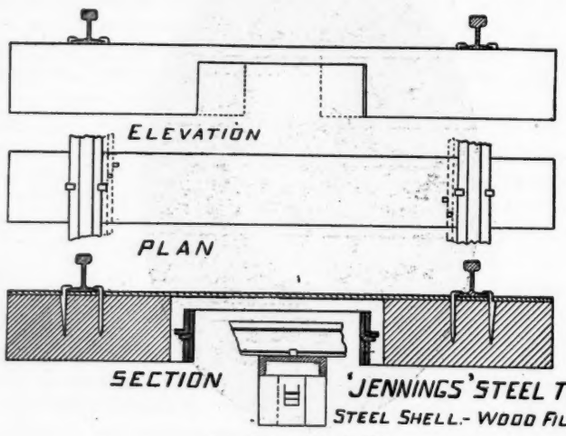
The growing realization of the desirability of adzing and boring ties before treating and of obtaining more perfect drainage by boring spike holes clear through the tie will tend to further increase tie life.

It is believed to be feasible, with the formulas and facts here presented, for any intending user of cross-ties to calculate the comparative cost of treated and untreated ties in any particular case; for instance: knowing the life and cost of an untreated tie and the estimated life of a treated tie which the investigator contemplates using in an ultimate economy will result; the cost of the treated tie may be ascertained. Also, given the life and cost of the untreated tie and the cost of the treated tie, the necessary economical life of the latter may be calculated. Such calculations are possible for comparisons of cost and life of ties of any materials.

THE USE OF METAL, COMPOSITE AND CONCRETE TIES.

As this committee has stated before, it is building up a history of cross-ties that will be good for reference to future generations and making reports only on those ties that have been put in the track and used by some steam or electric railroad.

JENNINGS COMBINATION RAILROAD TIE.—E. D. Jackson, division engineer, *Baltimore & Ohio Railroad:* "On January 27, 1906, five of these ties were placed in the eastbound main track just west of Ridley Street, Baltimore, Md. The ties were removed from the track on August 8, 1908, and were not used again." The officers on the division on which this test was made advise that they do not consider the construction of this tie would fulfill the requirements of ties in main track or other frequently-used tracks. It is thought that they would



Jennings Steel Tie.

buckle in the center if laid on curves. It is also their judgment that these ties could not be satisfactorily insulated.

For the information of the Association, the following, in regard to the Jennings tie, is given. On February 4, 1913, House Joint Resolution No. 393 was introduced by Representative W. J. Brown, Jr., of West Virginia. This resolution directed the interstate Commerce Commission to investigate and report on the use of the Jennings Combination Railroad Tie upon railroads engaged in interstate commerce. For this purpose the resolution provided that the Commission be authorized to employ persons who are familar with the subject, and use such of its own employes as are necessary to make a thorough investigation. In making this investigation the Commission may make a practical test of said appliance upon some railroad in the United States.

The resolution further provided that the Commission may at its discretion tabulate accidents upon railroads engaged in interstate commerce resulting from a spread of track, broken rail, and defective roadbed for the period covering the last five years and to report to Congress the number of persons killed or injured and the damage to property by reason of defects herein above mentioned, etc.

In addition to directing the Commission to recommend legislation and empowering them to issue subpœnas, administer oaths, etc., the legislation carried with it an appropriation of $25,000. On February 4, 1913, this resolution was referred to the Committee on Interstate and Foreign Commerce. The resolution is still with this committee.

Bessemer & Lake Erie Railroad: During the year 1913, this company has received 64,438 steel ties, and 92,300 ties are still due on their 1913 order; in addition to this, 3,200

ties of the same design as were installed by the Carnegie Steel Co., at Atglen, Pa., on the Pennsylvania Railroad have been received but have not yet been put in the track. This company will continue to use the steel tie almost exclusively on its main tracks from North Bessemer to Conneaut Harbor.

Chicago & Alton Railroad: H. T. Douglas, Jr., chief engineer, advises that the 63 Simplex ties, manufactured by the Chicago Steel Railway Tie Co., are still in the track and are giving the highest degree of satisfaction.

Mr. Douglas further states that all of the Kimball ties which were in their track at Lockport, Ill., have been removed. These ties were put in in October, 1905.

Chicgo, Burlington & Quincy Railroad: Geo. H. Bremner, engineer, Illinois District, gives the following information: "In March, 1911, this company installed 100 Universal Steel Ties in a running track at Chicago. The ties were spaced 21-in. centers, in gravel ballast, with light freight traffic. Oak ties were used at the joints, as no steel ties were furnished for this purpose. These ties are satisfactory and show no signs of wear. They are corroding slightly, about 1½ in. below the top of the tie."

Duluth & Iron Range Railroad: Two thousand Carnegie steel ties were put in their main track in 1905. These are still in the track and giving satisfactory service.

Duluth, Missabe & Northern Railway: This road put in 22,400 Carnegie steel ties in the fall of 1908 and spring of 1909. Two miles were placed between Duluth and Proctor on double track, one mile in each track, the remainder being placed about 50 miles north of Duluth on double track, 1½ miles on each track. These ties are giving excellent service.

Elgin, Joliet & Eastern Railway: Sixty-two Bates concrete ties were installed in the eastbound main track at Whiting, Ind., May 1, 1912. A. Montzheimer says, "They are holding up in good shape and as far as I can see are in as good condition as when first installed." In regard to the insulation of this tie, F. B. Wiegand, signal engineer, Lake Shore & Michigan Southern, advised, on December 4, as follows:

"I made personal test of this tie on June 30th and at that time we reported that we could not say whether or not the ties would be satisfactory where track circuits are in operation, although we knew there would be more leakage than where wooden ties were used, and the length of track section for the same battery would therefore be less with the reinforced concrete tie than with the wooden tie. Complete information could not be had at that time on account of steel ties being in service adjacent to the concrete ties and the section of track with the concrete ties not being insulated from the adjoining section. After this test, Mr. Bates wished to have this section insulated and a further test was made, after which we reported as follows: We had further test made but we could only determine with the number of ties in service that the leakage would be materially higher than with wooden ties and if ties are installed for test, we will without doubt have to provide short track sections. On account of the leakage, Mr. Bates suggested enameling the anchor plates."

During the past year this road put in 556 sets of Carnegie steel switch-ties, making 710 sets in to date, and further they have in 12,150 Carnegie steel cross-ties, the first of which were put in in 1907. These ties are giving satisfactory service.

New York Central & Hudson River Railroad:—Universal Metallic Tie.—On Feb. 10, 1911, this company installed 99 Universay ties in main track under 100-lb. rail, spaced 18 to a 33-ft. rail, in stone ballast, under heavy freight and express traffic. The ties are insulated, the insulation being renewed October 29, 1912. The blocks under the rail have never been renewed, but are decaying very fast. G. W. Vaughan, engineer maintenance of way, says the ties do not hold well in the ballast and it is expensive to renew rail on them. He states that the ties do not seem to have been affected as yet by salt drippings from refrigerator cars.

Pennsylvania Railroad: CARNEGIE STEEL TIES.—This company has installed 3,000 Carnegie steel ties of heavy design near Atglen, Pa., on their low-grade freight line, eastbound main track, on Dec. 1, 1913. The ties are not insulated, but the Carnegie Steel Company advises that they can be furnished with insulation, a piece of fiber being placed under the plate. These ties are placed in three sections of about 1,000 ties in each section, spaced 18, 19 and 20 ties to a 33-ft. rail. Part are in cinder ballast and part are in stone ballast. In addition to the above they laid 8 sets of No. 8 turnouts in Pitcairn, Pa., yard, two years ago and they have been giving satisfactory service. Eight more sets have been ordered.

MORGAN STEEL TIE.—A test of this tie is being made at Atglen, Pa. The ties are made from old rail by special machinery and a stretch 400 ft. long was laid about two years ago. No definite conclusion has been reached as to their economy.

Pennsylvania Lines (Northwest System): CHAMPION COMBINATION CONCRETE AND STEEL TIE.—Two hundred and three of these ties were placed in the westbound main passenger track Dec. 1, 1913, near Emsworth, Pa. The ties are on a curve of about 1 degree 30 min. They are insulated, and are placed out of face—spaced 19 to a 33-ft. rail—100-lb. P. S. section, rock ballast.

The weight of the steel in this tie is 140 lbs., the weight of concrete approximately 460 lbs., and the total weight 600 lbs. The tie is made of ¼-in. steel plate, and J. A. Hyle, the inventor, says the concrete is a 1:3:5 mix. The fastening on this tie is of special interest. On top of the tie is a plate 7 by 10½ in. for intermediate and 7 by 13 in. for joint ties. This plate may be rolled, but on the Emsworth ties it is made of cast steel. The projections on this plate are so formed that they hold the rail clip at all times square with the tie, a very important feature. This plate is insulated from the tie by a number of thicknesses of insulating paper or fiber which the inventor thinks will act as a cushion. In addition to providing for the track circuits, the bolts are insulated where necessary with thimbles or washers and the plate on the under side of the tie is insulated with fiber or insulating felt.

It will be noticed that the bolts holding the plate under the top table of the tie have the nut in a pocket in the concrete which permits the bolt to be tightened from the top.

L. A. Downs (I. C.), Chairman; G. W. Merrell (N. & W.), Vice-Chairman; A. M. Acheson (M. K. & T.), C. C. Albright (Purdue University), H. W. Brown (P. L. W.), W. J. Burton (M. P.), S. B. Clement (T. & N. O.), E. D. Jackson (B. & O.), H. C. Landon (W. & Y. R.), F. R. Layng (B. & L. E.), E. R. Lewis (D. S. S. & A.), R J. Parker (A. T. & S. F.), J. G. Shillinger (Rutland), D. W. Thrower (I. C.), H. S. Wilgus (P. S. & N.), Louis Yager (N. P.), E. C. Young (N. Y. P. & N.), Committee.

APPENDIX A.

COMPARATIVE HOLDING POWER OF DIFFERENT POINTED GOLDIE AND CUT SPIKES.

By H. B. MACFARLAND, Engineer of Tests, Atchison, Topeka & Santa Fe.

The object of this test was to determine the holding power of different pointed Goldie and chisel-pointed cut spikes and the tearing effect on the fiber due to driving the spike into the wood. A particular object was to determine what taper of Goldie spike was most advantageous. .Data were also obtained to determine if the Goldie spike should not be adopted as standard instead of the chisel-pointed cut spike.

The general dimensions, and other detailed information in regard to the spikes, are shown below:

No.	Point.	Point Length Inches.	End Inches.	Spike Length Inches.	Weight Grams.	Size of Spike Inches.
1	Chisel	1.1	0.05 by 0.55	5.80	260	0.57 by 0.56
2	Chisel	1.1	0.05 by 0.55	5.75	260	0.57 by 0.57
3	Sharp	1.1	0.06 Square	5.70	250	0.57 by 0.57
4	Sharp	1.0	0.07 Square	5.75	251	0.57 by 0.56
5	Blunt	0.5	0.25 Square	5.35	255	0.58 by 0.56
6	Blunt	0.5	0.25 Square	5.30	252	0.58 by 0.56
7	Blunt	0.8	0.25 Square	5.60	254	0.58 by 0.57
8	Blunt	0.8	0.25 Square	5.40	251	0.57 by 0.57
9	Blunt	1.25	0.25 Square	5.35	249	0.57 by 0.58
10	Blunt	1.15	0.25 Square	5.45	249	0.58 by 0.57
11	Blunt	1.70	0.25 Square	5.30	224	0.57 by 0.57
12	Blunt	1.60	0.25 Square	5.45	242	0.57 by 0.57

Three pieces of 6 in. by 6 in. by 3½ ft., hard pine dimension lumber untreated were secured for test. Three ties, one 6¼ in. by 8½ in. by 8 ft. hewn hard pine, treated; one 6¼ in. by 8½ in. by 8 ft. hewn red oak treated; and one 6⅝ in. by 8¾ in. by 8½ ft. hewn white oak, untreated, were also secured to be used in this test. At the conclusion of tests on the above specimens, six additional ties, two each of the above mentioned woods, were secured for further tests.

This test was made to determine only the relative holding power of the different-shaped spikes in the same wood; therefore, it was considered sufficient to make the determinations using the standard ⅝-in. hole, 4 in. deep. This was followed out with a few exceptions. In case of the hard pine untreated dimension lumber a 2½-in. hole was used in a few instances. In one series of special tests on the ties, the spikes were driven without holes.

The spikes were marked at a point 4⅛ in. from the end, and driven to this line; thus each spike was driven into the wood the same distance. The spikes were staggered so

as to split the wood as little as possible. They were pulled in the 100,000-lb. Riehle testing machine. After pulling the spike, the ties were sawed and split through the spike hole so as to note the effect of the spike on the fiber.

The average values for all pulls made from ⅝ in. by 4-in bored holes in all pine, red and white oak ties treated, shows the following order:

Spike Number.	Designation. Point.	Pounds Start.	Pull.
3 & 4	1-in. sharp	5,300	3,590
7 & 8	¾-in. blunt	5,160	3,700
11 & 12	1¾-in. blunt	5,110	3,080
5 & 6	½-in. blunt	5,020	3,615
9 & 10	1¼-in. blunt	5,010	3,040
1 & 2	1-in. chisel	4,590	2,920

And the following order for tons holding power per ton of metal:

Spike Number.	Designation. Point.	Pounds Start.	Pull.
3 & 4	1-in. sharp	9,510	6,440
11 & 12	1¾-in. blunt	9,400	5,670
9 & 10	1¼-in. blunt	8,870	5,370
7 & 8	¾-in. blunt	8,700	6,310
5 & 6	½-in. blunt	8,450	6,060
1 & 2	1-in. chisel	8,020	5,110

The columns headed "start" show the initial force required to overcome all resistances and start the spike, while those headed "pull" show the average resistance of each spike after it has been started and is being drawn from the hole.

In both of the above tables the spikes are ranked upon their relative resistance to the initial pull or start. The ranking order of the different spikes based upon the average resistance after the initial start, however, would be slightly different, but is consistent in that it shows the chisel-pointed spike inferior to all the others tested.

Conclusions.

These data show that the holding power of the 1-in. chisel-pointed spike is but 86.7 per cent that of the 1-in. sharp Goldie pointed spike, and from 1 to 10 per cent below that of the special blunt-pointed spikes tested. The injury done to the fiber of the wood is a maximum with the chisel-pointed spike and a minimum with the sharp-pointed spike. It is also greatly diminished with the blunt-pointed spikes. The chisel-pointed spike is harder to drive straight than the others, where tie plates are not used. There is little apparent difference in the holding power of the four forms of blunt-pointed spikes tested. The pull required to start the different spikes varied less than 3 per cent.

The Goldie spike is superior to the chisel-pointed spike not only in holding power, but on account of better alinement in the hole. Better holding power and less tendency to break down the wood fiber are obtained with spikes inserted in bored holes.

APPENDIX B.

HOLDING POWER OF CUT AND SCREW SPIKES.

By H. B. MacFarland, engineer of tests, Atchison, Topeka & Santa Fe.

The object of this test was to determine: The holding power of common cut spikes and screw spikes in different kinds of wood; the relative holding power and modulus of rupture of the various kinds of wood, and their compression strength.

Nine different kinds of ties were received for test, as follows: Three longleaf pine, 3 shortleaf pine, 3 red oak, 3 red gum, 3 Douglas fir, 3 balsam, 3 New Mexico pine, 2 Japanese oak and 2 ohia.

They were cut in two lengthwise to aid in handling. The Japanese oak and ohia were sawed ties. All others were hewn. These two ties were so hard that spikes could not be screwed into a ⅝-in. hole.

WEIGHT OF TIES.

Kind of Wood	Tie No. 1	Tie No. 2	Tie No. 3	Weight per cu. ft.
Longleaf pine	156 lbs., 7 oz.	156 lbs., 10 oz.	124 lbs., 3 oz.	41.1 lbs.
Shortleaf pine	110 " 7 "	98 " 3 "	103 " 7 "	41.0 "
Red oak	147 " 14 "	145 " 8 "	162 " 6 "	62.0 "
Red gum	145 " 4 "	136 " 12 "	138 " 0 "	43.5 "
Douglas fir	111 " 1 "	143 " 8 "	124 " 1 "	30.7 "
Balsam	105 " 3 "	107 " 5 "	107 " 14 "	30.3 "
New Mexico pine	136 " 7 "	134 " 0 "	152 " 0 "	29.9 "
Japanese oak	118 " 9 "	124 " 5 "	.....	46.2 "
Ohia	125 " 8 "	108 " 14 "	.....	47.3 "

The common spikes used were the ⅝-in. cut spike, which weighed 9½ ounces each, or 169 spikes per 100 lbs.

The screw spikes were the ⅞-in. rolled V-thread with ½-in. pitch. The diameter at the bottom of the thread was ⅝ in. Their weight was 19 ounces each, or 84 spikes per 100 lbs. All ties were thoroughly seasoned.

One half of the spikes were to be pulled immediately and the other half to be pulled one year later, with the ties exposed to weather conditions during the year. The common spikes were driven 4¾ in. deep with a maul, under four different conditions, each tie containing: Four spikes driven with no hole bored; 4 spikes driven with 7-16-in. hole bored; 4 spikes driven with ½-in. hole bored, and 4 spikes driven with 9-16-in- hole bored.

For the screw spike holes were bored and the spikes screwed in for 5 in. of their length with a wrench, each tie containing 2 spikes screwed into ⅝-in. holes and 2 spikes screwed into 11-16-in. holes.

A 200,000-lb. Olsen testing machine was used for pulling the spikes. The tie was laid across the top of the machine, the spike puller was attached to the movable head, passed through upper crosshead and hooked onto the spike. All spikes were screwed close to the tie before pulling, and again when the maximum load was reached, thus determining the amount of draw at maximum pull. The screw spikes averaged 5-16-in. draw before the maximum load was reached, their movement being gradual until pulled out. There was little movement to the common cut spikes until the maximum load was reached, then a sudden movement from 1-64 in. to ⅛ in., depending upon the character of the wood.

Thirty-three per cent showed a gradual creep until pulled out; 17 per cent showed a sudden jump of 1-64 in. at the maximum load, 22 per cent showed a sudden jump of 1-32 in. at the maximum load, 19 per cent showed a sudden jump of 1-16 in. at the maximum load and 4 per cent showed a sudden jump of ⅛ in. at the maximum load.

Following is the average holding power of the spikes in the different woods and with the different size holes bored:

COMMON ⅝-IN. CUT SPIKES.

Kind of Wood.	Pounds required to pull spike with various sizes of holes bored. No Hole.	7-16 in.	½ in.	9-16 in.
Red gum	3,265	3,478	2,872	2,786
Red oak	4,120	3,950	3,265	2,812
Longleaf pine	3,583	3,598	3,215	2,800
New Mexico pine	2,285	1,970	1,190	1,713
Shortleaf pine	3,323	3,870	2,275	2,282
Douglas fir	2,883	3,268	1,928	2,020
Balsam	2,968	2,540	1,913	1,718
Ohia	4,315	6,073	4,207	3,108
Japanese oak	6,595	7,650	4,853	4,760

SCREW SPIKES.

Kind of Wood.	Pounds required to pull spike with various sizes of holes bored. ⅝-in.	11-16 in.
Red gum	7,000	10,310
Red oak	9,055	11,090
Longleaf pine	11,970	10,990
New Mexico pine	6,025	5,195
Shortleaf pine	7,215	8,355
Douglas fir	8,555	8,333
Balsam	7,780	7,295
Ohia	Could not screw spike in	18,010
Japanese oak	Could not screw spike in	13,235

The transverse test was made on the sections of ties in which no spikes were driven in order to determine their modulus of rupture. These pieces were placed on the bed of the testing machine on two knife edges 40 in. apart, with a 4-in. iron plate over the knife-edges. An iron plate 3 in. wide was placed on top of the tie in the center under knife-edges, which was attached to the movable head of the machine. The deflection from no load to the breaking point was also noted. The modulus of rupture was calculated by the formula $R=\frac{3PL^2}{2BD^2}$ in which P is the breaking in pounds; L the length in inches between supports; B the breadth, and D the depth of the tie.

The following are the results obtained:

TRANSVERSE TEST OF TIES.

Kind of Wood.	Inches between Supports.	Load Applied.	Deflection.	Modulus of Rupture.
Douglas fir	40	40,550	1⅞ in.	4,920
Douglas fir	40	40,610	1 in.	4,910
New Mexico pine	40	41,700	1 in.	4,420
New Mexico pine	40	45,860	15-16 in.	4,525
Shortleaf pine	40	35,510	15-16 in.	7,290
Shortleaf pine	40	28,470	⅝ in.	5,645
Balsam	40	26,140	¾ in.	4,270
Balsam	40	30,000	½ in.	3,380
Red gum	40	36,450	1 in.	5,460
Red gum	40	41,950	1 in.	5,330
Red oak	40	30,680	¾ in.	6,020
Red oak	40	37,270	⅞ in.	8,610
Longleaf pine	40	47,160	⅞ in.	5,880
Ohia	32	50,910	⅝ in.	8,480
Japanese oak	30	50,000	½ in.	7,580

Compression Test.—The ties were hewn so unevenly that it was found impossible to get comparative results without squaring up a short section. Pieces 18 in. long were cut from the ends of the ties used for the transverse test and planed to 5⅜ by 7½ in. These pieces were then placed flat in the testing machine, a section of railroad rail was placed across them and the pressure applied to the rail sufficient to imbed it 3-16 in. and ⅜ in. in the tie.

The following table shows the pressure required to sink the rail in the tie, also the pounds per square inch pressure on the section. The weight per cubic foot of timber was calculated from the short sections, which were planed.

COMPRESSION TEST.

Kind of Wood.	Pounds to sink rail 3-16 in. deep.	Pounds per sq. in.	Pounds to sink rail ⅜ in.	Pounds per sq. in.
Shortleaf pine	39,050	1,225	47,190	1,480
Longleaf pine	27,405	860	34,560	1,082
Douglas fir	30,880	968	34,440	1,080
New Mexico pine	26,060	816	31,160	977
Balsam	23,560	739	27,560	863
Red gum	34,640	1,088	42,120	1,320
Red oak	41,670	1,306	53,350	1,670
Japanese oak	63,860	2,000	80,700	2,530
Ohia	76,720	2,400	88,710	2,780

The red gum, balsam, longleaf pine and red oak fibers were not broken at all by the rail in the compression test, which indicates a very elastic fiber in the wood. The Japanese oak and ohia show a very slight breaking of the fiber. Douglas fir, shortleaf pine and New Mexico pine presented very brittle fibers, which were broken considerably by the rail section when under compression.

The relative weight of the cut spikes as compared with the screw spikes is 1 to 2, and their relative maximum holding power averages 1 to 2½, respectively, thus indicating an advantage of 25 per cent for the screw spike over that of the cut spike, equal weights of metal being considered. It will be noted from the accompanying curves that in the majority of cases the cut spikes driven in the 7-16-in. holes require the greatest force to remove them. The longleaf pine exhibits about the same holding power with no hole and with 7-16-in. hole, while the red oak, balsam and New Mexico pine display a somewhat higher power with no hole bored for the spike.

With the screw spikes we have but seven compressions to make, since it was impossible to screw the spikes in ⅝-in. holes in the ohia and Japanese oak woods. In these seven cases, however, the red oak and the red gum, which are the hardwoods, reveal a much greater holding power with the spikes screwed into the larger hole, while the longleaf pine, Douglas fir, balsam and New Mexico pine, which are softwoods, the holding power of the spikes is somewhat higher with the smaller hole, although the difference is not so marked as in the case of the hardwoods.

Discussion on Ties.

L. A. Downs, chairman, presented the report.

Robert Trimble (Penn.): I think there is some doubt about paragraph b in the first sub-committee report. The Pennsylvania system is conducting at the present time a series of experiments to determine the comparative value of screw spikes and cut spikes. The majority of the committee who are looking after this experiment are almost at the point of recommending the abandonment of the use of screw spikes for dense traffic roads, and they seem to be almost unanimously of the opinion that the cut spike is better than the screw spike. Paragraph b is not going to prove true in this particular experiment. In fact, a great number of these screw spikes have become loose, and they can be lifted up. Experiments have been made with several devices which have been tried abroad in order to retain screw spikes, but no satisfactory method of repairing the difficulty that has been caused by these screw spikes becoming loose has been found, and I doubt very much whether it is safe to accept that as a definite proposition. We find the same trouble when the screw spikes are used with the tie plates.

Mr. Downs: I might say from the investigation that I have made on the Santa Fe that they had exactly the same trouble when they started. They did not know how to use screw spikes. They must be used properly.

Mr. Trimble: In this particular place, where this experiment is being conducted, we have all noticed this: That the amount of traffic coming over that particular piece of road, in order to maintain a screw spike track to perfection, would require a great deal more labor than where we have the ordinary spike.

W. M. Camp (Railway Review): I am gratified to find that the committee has found it advisable to recommend the boring of a hole for the drive spike. The reputation of the drive spike has suffered in the comparison with screw spikes, in that it injured the fiber of the wood. That comparison has never been fair, because the screw spike has been driven in bored hole, and the drive spike has been driven in to form a hole.

C. E. Lindsay (N. Y. C. & H. R.): I think probably the severest strain to which the ordinary track fastening of that kind is subjected is the horizontal component of the thrust, that is, in the plane of the tie. I have conducted some experiments recently by pushing the spike back through the tie, as it would be by the ordinary pressure of the rail base against the spike. The idea that the vertical pull of the spike was the great strain on the spike has led some inventors to design a tooth spike, where one face of the spike was serrated or toothed. Tests of spikes of that kind shows strains from 2,290 lb. to 3,270 lb., depending on the splitting of the wood in the sample. It required from 4,170 lb. to 4,920 lb. to push that same spike back through the tie. Another idea in the matter of the ordinary cut spike was to change the section of it from a square to truncated pyramid with the base against the base of the rail, with the idea to increase the area so as to reduce the amount of cutting of spikes. A spike designed along that line was tested and required from 2,610 lb. to 3,850 lb. to pull the ordinary spike, where the special spike took 2,290 lb., 3,090 lb. In backing the ordinary spike through the tie it took from 4,670 lb. to 3,750 lb., and in the case of the special spike it took from 4,770 lb. to 5,740 lb.

G G. Ray (D. L. & W.): We have made quite an extensive series of experiments between cut and screw spikes which I think will show very conclusively that the screw spike does not only have a very much greater pulling resistance, but also a much greater lateral resistance to rail pressure, that is, if the tie is bored out. As I remember it, in round figures, it has at least twice the lateral resistance as that of the cut spike. We have been using screw spikes for two purposes on main line work, both in renewals and in construction work. We have had no material trouble with loose tie plates when using a flat bottom tie plate with screw spikes. What trouble we may have, of course, I cannot foretell. On our eastbound main track, down the mountain, where the traffic runs from ten to twelve million tons per annum, we have curves of 5 and 6 degrees on a 1½ per cent grade. We have changed the rail three or four times on some of the curves where we have screw spikes without having to alter the gage of our track, laying the rail in on the old tie plate. I think that is pretty good evidence that they are not giving a great deal. We have in service a good many miles of solid screw spike track. The only material trouble we have had with screw spikes in maintenance work is where we have had one or two or three screw spike ties to the rail, and that has been in wet places, where there has been some little heaving perceptible in cold weather. We have had some screw spike heads broken off under such conditions. We have also had cases where screw spikes were broken off when being placed in service in white oak ties by not having the holes sufficiently deep. I do not believe we are going to have the trouble Mr. Trimble speaks of with enlarged holes, and I am sure our tie plates do not rattle. We had a few cases where they did, due to the fact that they were not properly set down when they were placed. We have mostly longleaf yellow pine ties, although we have in service a

good many chestnut ties, shortleaf beech, some maple, and a great many red oaks.

W. B. Storey (Santa Fe): We have used the screw spikes on the Santa Fe system almost entirely in pine, most of it rather soft pine, and we find that the tie plate does rattle after a week or two of service, on account of the plate sinking into the wood. We have to go over the track a second time, sometimes a third time, in order to get the plate down close. I also think that there is very great merit in Mr. Camp's suggestion that the comparison should be made between the cut spike in a bored hole rather than a cut spike under the old conditions, which most of us know of. I think further that the compression of the fiber of the wood, in the manner described by Mr. Lindsay, will, after the passage of two or three years, considerably affect the comparison between the cut spike in the bored hole and one driven home in the ordinary manner.

Mr. Ray: I do not think that with the screw spike you can get away from the necessity of going over the track after they have been put in and setting them down in the plates, because our plates are absolutely flat on the bottom. We find, in the case of our soft wood ties, due to the compression of the material, even with perfect bearing surface, there is some slight settlement. We have not had that trouble in the harder ties. One of the most aggravating things we have to deal with, and one which must be corrected sooner or later, is the matter of brine drippings from the cars. We find that the screw spikes, in places on curves where such trains stop, are very badly rusted, and I believe we are liable to have serious trouble with the heads of the spikes rusting to such an extent that it will be hard to get them off. Furthermore, we have not had any serious trouble on account of derailments, with the screw spikes in the wrecked track. We had one case where some derailed cars took out all the cut spikes in the track for about two miles on one side of the rail, and there was not one out of twenty of the screw spikes which were so injured as to affect their holding power.,

Mr. Storey: The sole intent of the rib as used on the Santa Fe tie plate is to prevent lateral motion, and was put on primarily to help us in holding the gage on very curved mountain work. We found it was no detriment to the tie and that it does not cut the fiber materially.

Mr. Ray: Screw spikes have been driven both by hand and by power. We have been trying to get a machine so that we could drive the screw spike down and have it driven down with the same strain in each case. We had a good deal of trouble getting such a machine and we found it nearly impossible to get any sort of an appliance that would kick the driver out at the right time. Most all of our work has been done by hand. In the field it has been done by hand entirely. So far as the holding power of the ties is concerned, we have in a great many cases taken our our old tie plates and put in new, double-spiked them, and have found that we are getting a good deal more life from the ties which we otherwise would have had to take out. I speak especially of white oak itself.

Mr. Ray: Our experiments were started to find out what size of holes we could put in the different classes of wood for the screw spikes and also for the cut spikes, as we had been boring all of our ties before they were treated. It is quite essential to have the proper hole in the tie.

C. H. Cartlidge (C. B. & Q.): One of the questions, to my mind, is how much can we afford to pay for a concrete tie in order to make it commercially practical. I believe, after investigation, that a practical tie can be designed. I will suggest that for future work of the committee an investigation be made as to the amount which can be paid for a concrete tie which will give a life of, say, thirty years.

SIGNS, FENCES AND CROSSINGS

The following subjects were assigned for consideration:

(1) Continue the investigation of ways and means for securing a proper quality of fence wire to resist corrosion and secure durability.

(2) Concrete and metal for signs and signals as compared with wood.

(3) Concrete and metal as compared with wood for fence posts.

INVESTIGATION OF WAYS AND MEANS FOR SECURING A PROPER QUALITY OF FENCE WIRE.

The Secretary of the Association, under date of September 11, 1913, issued a circular prepared by the committee to the various railroads represented in the Association, making inquiries in regard to present practices and recent developments, for the purpose of securing a proper quality of fence wire. Only 35 replies were received, and the information imparted is vague and unsatisfactory.

A careful analysis of the replies received failed to develop anything of a new or tangible nature, and the committee feels that it can add nothing of value to what has already been presented to the Association upon this subject. It, therefore, reluctantly concludes that it will be well to discontinue any further consideration of the matter for the present, to permit a sufficient time to elapse to enable those few roads that are trying to make some progress in the development of a better quality of fencing wire to conclude their investigations.

CONCRETE AND METAL FOR SIGNS AND SIGNALS AS COMPARED WITH WOOD.

A circular submitting the following inquiries for information was prepared and sent by the Secretary of the Association to 400 representatives of railroad companies in the United States, Canada and Mexico:

Sixty replies were received, nearly all of which contained some information useful to the committee, either in the form of standard plans, rulings of utilities commissions, abstracts of laws relating to the maintenance of signs signs at public highway crossings, or laws relating to trespassing on railroad property. A cursory examination of the information

C. H. STEIN,
Chairman Committee on Signs, Fences and Crossings.

received suggested a natural sub-division of it into two classes: one applying to the general public, the other to the employes of railroad companies.

Owing to the scope of the subject covered by the information at hand, the committee considered it inexpedient at this time to take under consideration any signs except those in which the public is directly interested. On account of the great number and variety of these signs, it has confined its efforts to compiling information on the three signs in which the public is most vitally concerned, viz: public and private road crossing and trespass signs.

A table was prepared to show in condensed form detailed information as to the standard practice of the various railroads of the country, giving general dimensions, size of letters, color of paint, cost and inscriptions of standard crossing signs used by 46 railroads from which replies have been received. Attention was called to the fact that of the above number 42 railroad companies are using wood signs consisting of a post about 16 ft. long, with two blades attached to the top of same at angles ranging from about 40 degrees to 90 degrees; 14 have added a horizontal board below the inclined blades bearing various inscriptions; 3 are using elliptical metal signs; 2 rectangular boards; 3 a square frame attached to the post diagonally, and 2 triangular frames. Of the entire number of standard plans furnished there is but one sign in which concrete was used, except in anchoring the posts in the ground.

The states of Indiana and New Jersey, through their Public Utilities Commissions, have prescribed forms of crossing signs that have been adopted as standard for use in those states. They have also provided that in the case of two or

more railroads paralleling each other within certain distances the signs shall designate the number of railroads to be crossed. There are three or four different forms of signs in use in the State of New York which have been accepted by the Public Service Commission.

Herewith is submitted a diagram showing the various types of road crossing signs in use. While in only a few cases do any two roads agree as to details, in a general way the six types presented are fairly representative, and all in use could be grouped under the six classifications shown.

An attempt was made to secure copies of laws in every state affecting the size, design, etc., of signs to be placed at highway or street crossings. It was found difficult to secure them for each state, but we did succeed in getting them as in force in 32 states and Canada, as well as the decrees and rulings of the Public Utility or Railway Commissions of Connecticut, Indiana, New Jersey and Rhode Island. There are no laws in effect in regard to signs at highway crossings in Colorado, Louisiana, Nebraska or Oregon.

It may be of interest to scan quickly the inscriptions and size of letters required by each state, as with two exceptions they are the principal features of the laws and rulings; we, therefore, submit them below:

STATUTORY INSCRIPTIONS, ETC., ON CROSSING SIGNS.

State.	Inscription.	Size of Letters.
Alabama		
Arkansas	Railroad crossing; look out for the cars	9 in.
Arkansas	Railroad crossing; look out for the cars while bell rings or whistle sounds	9 in.
Canada	Railroad crossing	6 in.
Colorado		
Connecticut		
Delaware	Railroad crossing	5 in.
Florida	Look out for the cars	9 in.
Illinois	Railroad crossing, or, look out for the cars	9 in.
Indiana	Railroad crossing—danger	9 in.
Iowa		
Kansas	Look out for the cars	5 in.
Kentucky	Railroad crossing	5 in.
Louisiana		
Maine	Railroad crossing	
Maryland		
Massachusetts	Railroad crossing; look out for the engine	9 in.
Michigan	Railroad crossing	12 in
Minnesota		
Mississippi	Railroad crossing, or, look out for the locomotive	
Missouri	Railroad crossing	9 in.
Nebraska		
New Jersey	Look out for the locomotive	9 in.
New York	Railroad crossing, look out for the cars	
North Dakota		
Ohio		
Oklahoma	Railroad crossing, look out for the cars	8 in.
Oregon		
Pennsylvania		
Rhode Island	Railroad crossing, stop, look and listen	9 in.
South Dakota	Railroad crossing, look out for the cars	8 in.
Tennessee	Look out for the cars when you hear the whistle or bell	
Texas		
Virginia	Railroad crossing	5 in.
Washington		
West Virginia	Railroad crossing, look out for the locomotive	
Wisconsin	Look out for the cars	

The committee finds that only three of the roads that submitted plans use standard road crossing signs made of metal, with metal posts; the balance uniformly use wood. One has used a sign and post made of concrete, but it does not commend itself. Another uses a wooden sign with a concrete post, but this is in an experimental way, and has not yet been tested out for merit.

The objects to be achieved in the selection of a proper form of road crossing sign are reasonable cheapness in first cost, economy in maintenance, which includes durability, and the merit of serving the purpose for which it is placed, that is, to give proper and ample warning of the existence of a railroad crossing. The committee, therefore, presents a design of sign which, in its opinion, most adequately meets these conditions. It should be made with wooden blades 12 in. wide and 8 ft. long, with mitred ends placed in a diagonal manner with an angle of 50 degrees between blades on an 8-in. by 8-in. by 16-ft. wooden post. The post should stand 4 ft. in the ground, and be creosoted from bottom to 6 in. above ground line. The lower 9 ft. of the post should be painted black, and the balance white. The blades should be painted white with black letters, and ½-in. black border around blades. The border and lettering should be on both sides. Letters should be Egyptian style, 9 in. high, with the exception of connecting terms, as "for the" in the recommended sign, which should be 4 in. high.

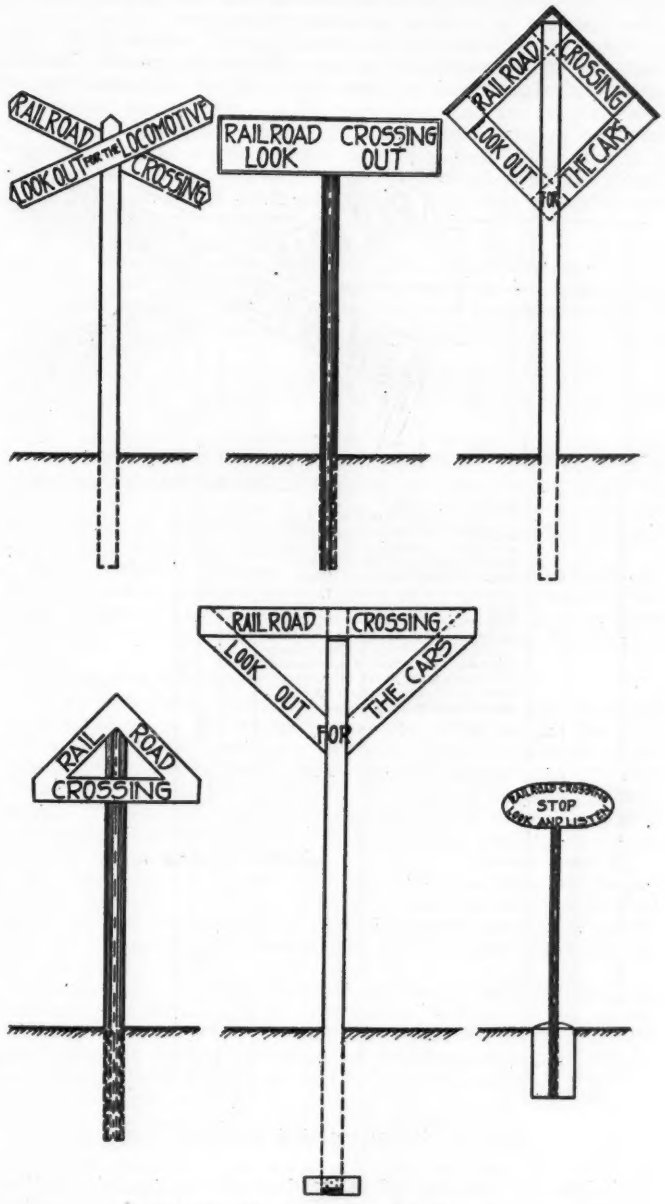


Fig. 1. Typical Crossing Signs.

One large trunk line has adopted a modified form of this sign made of cast-iron on wrought-iron pipe post. The committee has not felt warranted in recommending it for the reasons that it is quite expensive, and it has been tried out for but a short period of time; hence, any disadvantages in its use may not have developed.

The committee also made an investigation of the various kinds of trespass signs in use by the railroads. Replies were received from 28 roads, submitting 46 forms of signs, differing in style, phraseology, etc. We are presenting below a table giving a brief description of the sign in use on each road, as well as prices delivered f. o. b. line of road, and cost in place to the extent that such data was available.

Inquiry was also made as to the laws in force in the various states and Canada, relating to the subject of trespassing. We obtained the text of such laws for 28 states and Canada. In order that the substance of these laws may be quickly referred to, we are presenting brief synopsis of them herewith.

Synopsis of Laws Relating to Trespassing on Railroad and Private Property.

ARKANSAS.—No laws relative to trespassing on tracks or right-of-way. Railroads liable for killing trespassers, if negligence is shown.

CANADA.—Law very explicit and complete for various classes of trespassers.

CALIFORNIA.—Has law prohibiting use of right-of-way by vehicles, but is weak on common trespassers.

COLORADO.—There is no statute with reference to trespassers upon railroad property. There are certain statutes which designate as crimes the turning or operating of

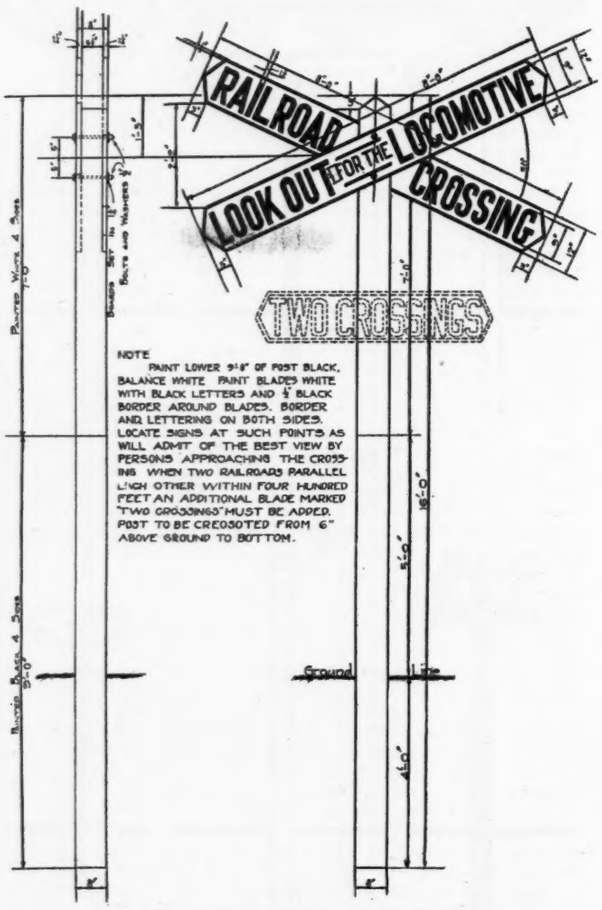

RAILROAD
LOOK OUT FOR THE LOCOMOTIVE
CROSSING
TWO CROSSINGS
NOTE
PAINT LOWER 9'-6" OF POST BLACK. BALANCE WHITE PAINT BLADES WHITE WITH BLACK LETTERS AND ½" BLACK BORDER AROUND BLADES. BORDER AND LETTERING ON BOTH SIDES. LOCATE SIGNS AT SUCH POINTS AS WILL ADMIT OF THE BEST VIEW BY PERSONS APPROACHING THE CROSSING WHEN TWO RAILROADS PARALLEL EACH OTHER WITHIN FOUR HUNDRED FEET AN ADDITIONAL BLADE MARKED "TWO CROSSINGS" MUST BE ADDED. POST TO BE CREOSOTED FROM 6" ABOVE GROUND TO BOTTOM.
Ground Line

Fig. 2. Recommended Crossing Sign.

ILLINOIS.—Has no general statute prohibiting trespassing on railroads, but has rather stringent regulations on malicious trespass and stealing rides.

IOWA.—Malicious trespass fully covered, but no law relative to trespass on railroad property.

KANSAS.—Has no statute specifically covering trespassing on right-of-way, but has very complete law covering malicious trespassing.

KENTUCKY.—Has no statutory regulation on trespassing, but Court of Appeals has announced that the company is only responsible for injury to a trespasser which could have been prevented by ordinary care.

LOUISIANA.—Has statute on stealing rides, but none relative to trespassing on railroad tracks or property.

MAINE.—Trespass statute fully covers all forms of trespass on railroad property or tracks, and releases company of liability if law is properly posted.

MARYLAND.—Statute covers stealing rides on trains, but is silent on common trespass.

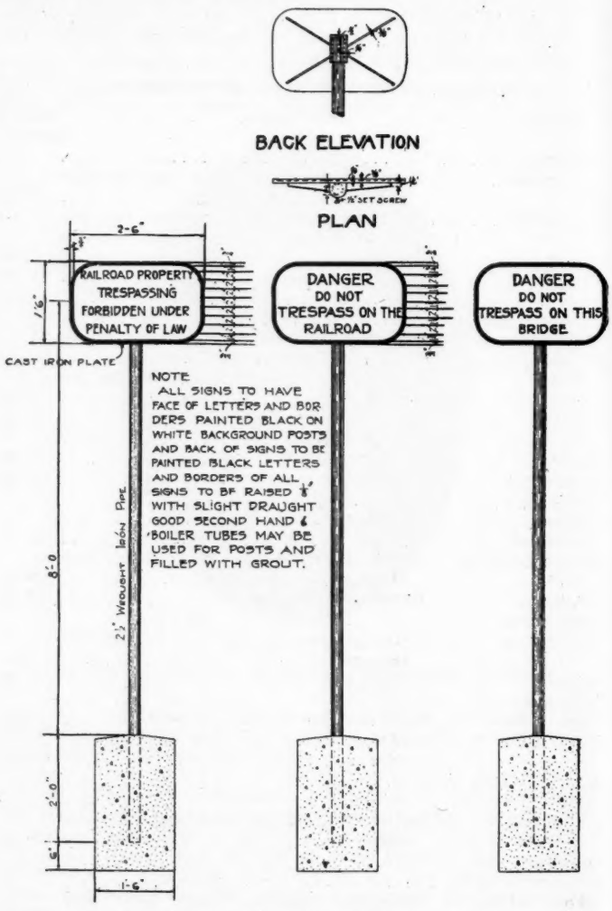

BACK ELEVATION
PLAN
RAILROAD PROPERTY TRESPASSING FORBIDDEN UNDER PENALTY OF LAW
DANGER DO NOT TRESPASS ON THE RAILROAD
DANGER DO NOT TRESPASS ON THIS BRIDGE
CAST IRON PLATE
NOTE
ALL SIGNS TO HAVE FACE OF LETTERS AND BORDERS PAINTED BLACK ON WHITE BACKGROUND POSTS AND BACK OF SIGNS TO BE PAINTED BLACK. LETTERS AND BORDERS OF ALL SIGNS TO BE RAISED ⅛" WITH SLIGHT DRAUGHT GOOD SECOND HAND 6" BOILER TUBES MAY BE USED FOR POSTS AND FILLED WITH GROUT.

Fig. 3. Recommended Trespass Signs.

switches, and the use of railroad tracks by use of a railway bicycle, push car, hand car, slide, or other similar vehicles or device, excepting such as are provided by said railroad company to be used for such purpose; and also providing for the punishment of parties, guilty of the removal of waste or packing, or brass or brasses, etc., or throwing stones at the train.

CONNECTICUT.—Law applies particularly to stealing rides and malicious trespass; not to common trespass.

DELAWARE.—Law applies to trespass on private land and railroad cars; not explicit on trespassing on railroad tracks or right-of-way.

FLORIDA.—General trespass law, but no specific reference to trespass on tracks or right-of-way.

IDAHO.—Applies to disorder on trains and refusal to pay fare; does not cover trespass on track or right-of-way.

INDIANA.—General trespass law covering trespass on private property and would apply to railroad tracks and property; also law covering interference with brakes and signals.

MASSACHUSETTS.—Trespass statute covers trespass on tracks or right-of-way. No provision covering malicious trespass.

MICHIGAN.—Statutes do not cover trespassing on railroad tracks or property, nor malicious trespass. Not broad enough to cover trespass on railroad property.

MINNESOTA.—Statutes cover both malicious and common trespass on railroad property.

MISSOURI.—Law covers trespass on tracks of railroad companies; but does not include malicious trespassing.

MONTANA.—Statute covers matter of disorder or refusal to pay fare, use of force to expel, etc., but does not cover trespass on tracks or right-of-way.

NEBRASKA.—General law covering malicious trespass, but scarcely applicable to railroad property.

NEW YORK.—Covers trespassing on railroad tracks, but not malicious trespassing.

OHIO.—Statute covers trespassing by team on tracks and right-of-way, stealing of rides and malicious trespass, but not walking on tracks.

OKLAHOMA.—Covers malicious trespass and preservation of order on railroad property.

OREGON.—Covers malicious trespass, unauthorized riding of equipment and trespassing on tracks.

PENNSYLVANIA.—Statute covers malicious trespass and unauthorized riding on trains. Trespass signs must be worded as follows: "Notice.—This is private property and all persons are hereby warned from trespassing thereon under penalty of the law, as provided in the Act of Assembly passed April 14th, 1905."

RHODE ISLAND.—Statute covers trespass on right-of-way; no provision for malicious trespassing.

SOUTH DAKOTA.—Malicious trespass only. No statute governing common trespass on tracks or right-of-way.

TENNESSEE.—Specified precautions to be taken to prevent accidents on railroad to trespassers.

UTAH.—Statute deals with unauthorized riding of equipment.

VIRGINIA.—Covers malicious trespass, walking on tracks, stealing rides, disorderly conduct, etc.

WEST VIRGINIA.—Covers trespassing on trains and disorderly conduct.

WASHINGTON.—Statute covers trespassing on railroad right-of-way and malicious destruction of railroad property.

It will be observed that there are no statutory regulations with regard to the form of sign, character of wording to be employed, etc., except in the State of Pennsylvania, which specifies that the sign should read "Notice—This is private property and all persons are hereby warned from trespassing thereon under penalty of the law as provided in the Act of Assembly passed April 14th, 1905."

The signs of this character in most general use are made of wood, with wooden post, but there seems to be a greater tendency to use a cast-iron or steel plate with wrought-iron post than in the case of the crossing signs. We also find that a number of roads that are now using wood are considering the feasibility of going to a metal sign. The size of signs, wording, character of lettering, etc., varies with each road and scarcely any two of them are alike. The only similarity exists in the cases of those roads which have adopted metal signs. The cost of metal signs is but slightly in excess of the cost of many styles of wooden signs. It is the experience of those roads which formerly used the wooden signs and later adopted those of metal, that the metal sign, while slightly more expensive in first cost, is more durable, and can be more easily maintained, including repainting.

The committee, therefore, presents a form of sign which would seem to most nearly conform to what is required in the way of reasonable first cost, durability, neatness and legibility. The wording on same might conform to the judgment of the management of each particular road, where statutory regulations do not provide for the form of wording.

These signs should be made of cast-iron ¼-in. in thickness with the borders raised ⅛-in., with slight draught; they should be 1 ft. 6 in. deep by 2 ft. 6 in. wide, with ⅜-in. diagonal cast ribs on back for stiffness; all signs to have face of letters and borders painted black on white background; posts and back of signs to be painted black, letters to be raised ⅛-in. with slight draught; 2½-in. wrought-iron pipe, or good second-hand boiler tubes filled with grout to be used for posts. When concrete or stone foundations are not used, the pipe is to be planted 3 ft. 6 in. deep in the ground and a 1-in. diameter gas pipe about 18 in. long should be run through the pipe post about 1 ft. below ground line to keep it from turning. The wording indicated on typical signs presented, "RAILROAD PROPERTY—TRESPASSING FORBIDDEN UNDER PENALTY OF LAW," or "DANGER—DO NOT TRESPASS ON THE RAILROAD," is suggested.

CONCRETE AND METAL AS COMPARED WITH WOOD FOR FENCE POSTS.

It was determined to undertake to have exhaustive tests made to ascertain the actual strength of the various kinds of concrete posts under different conditions. Sample posts to be secured from the different railroads using them. Arrangements have been made to conduct the tests. They will be supervised and financed by the Universal Portland Cement Company, and made at the Lewis Institute of Chicago, to both of which the committee is indebted for the manifestation of interest. The results of these tests will not be in shape for presentation for some time yet.

CONCLUSIONS.

The committee recommends:

(1) The adoption of the specifications and plan for highway crossing signs.

(2) The adoption of the specifications and plan for public trespass signs.

C. H. Stein, chairman (C. R. R. of N. J.); G. E. Boyd, vice-chairman; R. B. Abbott (P. & R.), H. E. Billman (M. P.), E. T. Brown (B. & O.), B. M. Cheney (C. B. & Q.), A. C. Copland (C. & O.), F. N. Crowell (P. L. W.), Arthur Crumpton (G. T.), J. T. Frame (C. G. W.), L. E. Haislip (B. & O.), C. M. James (A. C. L.), Maro Johnson (I. C.), L. C. Lawton (A. T. & S. F.), J. B. Myers (B. & O.), G. L. Moore (L. V.), C. H. Splitstone (Erie), J. A. Stocker (T. & O. C.), W. F. Strouse (B. & O.), W. D. Williams (Cin. Nor.), Committee.

Discussion on Signs, Fences and Crossings.

C. H. Stein, chairman, presented the report and recommended the adoption of Conclusion 1, concerning highway crossings.

Mr. Lindsay: The more I see of conditions around highway crossings, and the increasing number of paved streets requiring signs to be set on the curb lines, and the increase in size, velocity and character of vehicle traffic on the highways, the more I am impressed with the fact that signs so placed are hardly visible. In New England the railroad crossing signs are 10 or 12 ft. long, which extend out over the track. The more I think of it, the more I admire it as the proper device. The sign must be made more visible than this sign. We ought to adopt a sign that will give better results in this respect.

Mr. Hunter McDonald: The line with which I am connected has used reinforced concrete posts for supporting signs for the past seven or eight years, and we have found it very satisfactory. I, therefore, move to amend the plan of the committee by adding the words, "Unless made of reinforced concrete."

The President: The committee states that they have no objection to the amendment, and by unanimous consent this note will be added.

Mr. Lewis: In Appendix A I don't see anything about the regulations of Canada, but I recollect that in Canada they stipulate the minimum height for crossing signs shall be 16 to 20 ft. It appears that the higher you get a sign the more costly is the maintenance, because the wind has greater effect on a high sign than on a low one.

Mr. Lindsay: I feel that the road crossing signs as designed in most cases, are not sufficiently conspicuous to serve practical purposes, and they are becoming less so. I move that this sign will be referred back to the committee for further study.

The motion was seconded.

W. H. Courtenay (L. & N.): The committee has produced a sign which is in common use, the lettering of the sign differing in various sections. It is the practice on road crossings, where there is heavy traffic or at crossings where trains cannot be seen a long distance, to erect a special highway alarm. I think the recommendation of the committee does not prevent roads adopting highway signs, audible or otherwise in different cases.

Mr. Baldwin: I concur with the views of Mr. Courtenay. Where special conditions exist they can be met by special signs, but we do not wish to go to too great expense in adopting something of very general use, and in many places where the travel is slight.

Mr. Burpee: I think there is too much lettering on this sign and the letters are so crowded as to make them almost illegible at a distance. I think the words "railroad crossing" are sufficient for the purpose of warning, and that if you use simply those words you will accomplish sufficient. I think two boards are very good, because the form of the letter X indicates crossing, and it is more conspicuous.

Mr. Lindsay: My object in asking the committee to reconsider this subject is to seek a design of sign that can be built and maintained practically at no greater expense than the sign that they have proposed, but which will better meet the conditions required. A sign across the road is illuminated at night by the headlights of an automobile: This sign is never seen until after the accident has happened. These signs are required no matter what other devices you put up. I ask for a more conspicuous road crossing sign.

Mr. Sullivan: I move that we use the words "Railway crossing" or "Railroad crossing," using two boards for the sign.

J. B. Jenkins (B. & O.): I think the objections which Mr. Lindsay states can be answered. Where, in nearly all of the places he spoke of this crossing sign as not suitable, crossing gates are needed. I would second Mr. Sullivan's motion.

Mr. Stein: You will note in the text a statement in reference to the sign not being clearly seen 150 feet from the crossing. In such a case it shall be erected 150 feet from the crossing.

The President: The question is on the adoption of that conclusion. Mr. Stein moves that the design on page 873, together with the specification on page 872 be adopted. Mr. Lindsay moves an amendment to the effect that this subject be referred back to the committee for further study.

(The amendment of Mr. Lindsay was put to vote and lost.)

The President: The motion now is that the design on page 873, together with the specifications on page 872, be adopted, as recommended practice.

H. R. Safford (G. T.): I think we are going too far in specifying creosoting in any form, whether painting or treating. The use of the creosoted timber posts is purely an economical question. There is a large portion of the country in which a railroad would not be justified in using creosote, where the cost of the untreated timber is so low and the cost of the treated timber so high, that it would not be logical to use it.

Mr. Safford: I offer my suggestion as an amendment, that all reference to the subject of creosoting be omitted from these specifications.

The amendment made by Mr. Safford was put to vote and carried.

The President: The motion introduced some time ago by Mr. Sullivan was seconded by Mr. Jenkins, to the effect that the wording now shown on the sign be changed to either "Railway crossing" or "Railroad crossing," and that it be stated that the type of letters and size of letters shown are simply typical, is now in order.

Mr. Stein: The Committee states with the permission of the convention that it will accept the changes indicated in Mr. Sullivan's motion.

Mr. McDonald: Will the committee accept the further suggestion that a notation be added that the inscription on the sign conform to the local rules?

The President: Without objection on the part of the convention, the committee will accept that modification.

Mr. Jenkins: I move that the clause which is to be inserted in regard to concrete posts and which has been accepted by the committee, be stricken out again, and that the title of the sign be changed to read, "Wooden crossing sign."

(The motion was carried.)

Mr. Stein: The next question taken up by the committee was the consideration of trespass signs. The committee presents a form of design which would seem to meet almost generally with the requirements under this heading, and they have prepared a plan of trespass sign. I want to make it clear again that the wording on that sign is not the wording the committee recommends. The committee simply presents it as the typical form of wording. The committee moves that the specification and typical design presented be approved and printed in the Manual.

Mr. Lindsay: There has been some comment regarding the wording of the sign. I understand the committee is willing to put any desired wording on the sign, or to leave the wording off—

Mr. Stein: Yes.

Mr. Campbell: I wish to ask the committee if it would have any objection to omitting the diameter of the pipe. Boiler tubes vary in diameter and possibly you might leave that to the judgment of the railroad company as to the diameter of the pipe. We might use any boiler tubing we have on hand.

Mr. Stein: Nearly all of these details are optional with the railroad company.

The President: The question is on the adoption of the conclusion as recommended practice.

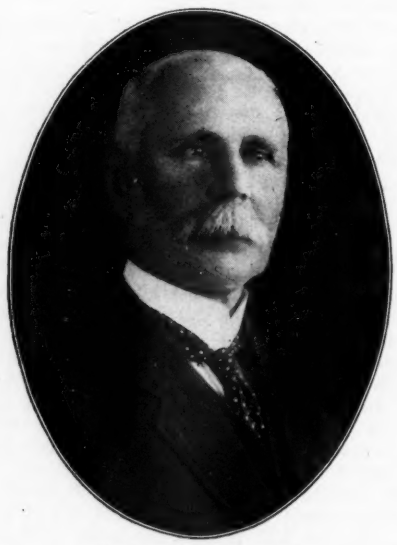
(The conclusion was put to vote and adopted.)

CONSERVATION OF NATURAL RESOURCES

The Committee on Conservation of Natural Resources was formed in 1908, its object being to keep in touch with the general work of Federal, State and Provincial Conservation organizations, and more particularly with the features of such work of specific and general interest to railways, in order to report on such proceedings to this Association. It is noted with satisfaction that the influence of the spirit of conservation, in a broad and complete sense, is rapidly enlarging, and the various sections of the Continent, acting through the regular organizations, are becoming more impressed with a desire that the great principles embraced therein should receive prompt and more general attention.

The committee has kept in touch with the work of two great organizations, the National Conservation Congress and the Commission of Conservation for the Dominion of Canada, and has been able to secure a mass of valuable data touching forests, timber preservation, water powers, fuels (including oil), etc. They were unable, however, as yet, to obtain certain details in order to make the statement sufficiently comprehensive, and as this report is merely one noting progress, it has been deemed advisable to defer publishing such data until it can be correlated in order to represent the whole continent.

A question which has been asked in a letter from one of our members engaged in railway work in northern Canada concerning oil for fuel may be interesting. The nature of the inquiry is as follows: "I take the liberty of suggesting that the question of oil fuel is one which our Association, through its committee on Conservation of Natural Resources, should consider fully and in great detail. We engineers who are working in the far North are, in a few years, going to be confronted with the question of fuel costs * * * ." The committee would state that in many lines of industry, oil fuel is rapidly displacing coal. The great increase in oil-burning mileage of railways is due to the fact of the saving in operating expenses. The Great Northern Railway uses oil exclusively on 115 miles of the Cascade Division. The Canadian Pacific has installed oil burners on its main line between Kamloops, B. C., and Field, B. C., a distance of 260 miles; also on the Arrow and Okanagan branches, an aggregate length of 79 miles; and on the Esquimalt & Nanaimo, between Victoria and Alberni on Vancouver Island, a distance of 134 miles. Fifty per cent of the locomotives on the division between North Bend and Vancouver have been converted to oil burners, and the remainder are now in course of alteration. The Grand Trunk Pacific contemplates the installation of oil-burning engines on the Mountain division as soon as its line is completed. The steamships of the Grand Trunk Pacific, as well as those of the Canadian Pacific, operating on the Pacific Coast, burn oil, and other Pacific Coast vessels have been changed from coal burners to oil burners. The oil is obtained from the California fields. No fuel oil is as yet produced in Canada, but if the Athabaska fields are successfully developed, as seems probable, the supply will be practically unlimited.



WILLIAM McNAB,
Chairman Committee on Conservation of Natural Resources.

As a mark of the importance that the subject of Conservation is held in Canada and of the interest the railways have in the proper care and exploitation of natural resources, it may be stated that some of the railway systems are entering into the spirit of it in a keen and business-like manner. One of the great transcontinental roads—the Canadian Pacific—has created a Department of Natural Resources under the immediate direction of a competent engineer and administrator. This department controls all the natural resources of the company, such as lands, mines and industrial and forestry branches, and it is particularly interested in seeing that every acre tributary to its lines produces what the soil is specially adapted for, and that it will furnish a full complement of such products, whether they be agricultural or forest.

One of the important features of practical forest conservation is the development of methods whereby the so-called inferior species of timber may be used in the place of more valuable species, the supplies of which are becoming rapidly reduced, or the prices of which have become so high as to

render impracticable their use for many purposes. This feature is the lengthening of the life of timbers by preservative treatment, thereby decreasing the drain upon the forests. The practice of using preservative treatment for ties in Canada is of quite recent origin.

The committee therefore earnestly recommends to the members of this Association the study and practice of timber preservation, both as an economic proposition and as a check on the rapid depletion of our forests.

William McNab (G. T.), chairman; C. T. Fisk (consulting engr.), vice-chairman; R. H. Aishton (C. & N. W.), Moses Burpee (B. & A.), F. F. Busteed (C. P. R.), A. W. Carpenter (N. Y. C. & H. R.), G. A. Mountain (Canadian Ry. Commission), W. L. Park (I. C.), G. H. Webb (M. C.), and R. C. Young (L. S. & I.), Committee.

Discussion on Conservation of Natural Resources.

William McNab, chairman of the committee, presented the report.

William McNab: I move that this report be received as information and progress.

Mr. McNab's motion was put to vote and carried.

ECONOMICS OF RAILWAY LOCATION

It is felt, that in order to be of definite value, the work of the committee should be performed by men who can give up their time to investigations, and with that in view, the

R. N. BEGIEN,
Chairman Committee on Economics of Railway Location.

chairman has requested that the work of the Committee on Economics of Railway Location be performed under the direction of the present chairman, or of someone who shall be selected in his place, by a force of men who can give their undivided attention to the work for a space of six months, at least. These men will report to the committee as a whole, and either revise their work in accordance with the criticism of the committee, or secure the approval of the committee, if the work is suitable. The chairman has, therefore, asked the Board of Direction to furnish authority and funds to conduct the work in that manner.

The work of the committee in the future must necessarily involve the analysis of a great many figures, the detailed working out of examples, the construction of many drawings, profiles, etc., and a great deal of figuring. It is felt that if this work was done by men who could devote their entire time to it, results of value to the railroad profession at large could be accomplished. To do the work in any other way must necessarily mean slow progress and, possibly, inaccurate conclusions.

It is therefore recommended that the sum of $400 per month for about six months be appropriated to employ I man at $200 per month, I man at $125 per month, and 1 man at $75 per month. This force should report directly to the chairman, who will submit the results to the committee as a whole for their approval, and if approved, to the Association.

It is our understanding that this matter is now before the Board of Direction.

R. N. Begien (B. & O.), Chairman; F. H. Alfred (P. M.), A. C. Dennis (Contr. Engr.), F. W. Green (L. & A.), L. C. Hartley (C. & E. I.), P. M. LaBach (C. R. I. & P.), J. DeN. Macomb (A. T. & S. F.), C. W. P. Ramsey (C. P. R.), A. K. Shurtleff (C. R. I. & P.), F. W. Smith (Contr. Engr.), H. J. Simmons (E. P. & S. W.), John G. Sullivan (C. P. R.), Walter Loring Webb (Cons. Engr.), M. A. Zook (Cons. Engr.), Committee.

MINORITY REPORT.

We do not think this a good time to ask for an appropriation. Should such be made, however, salaried employes should work under the general directions of the committee through its chairman; but in no case should they be employed until sufficient data is on hand ready for analysis.

It has been our opinion, and is now, that this year's work should have been a continuation of the investigations of last year—an analysis of maintenance expenses to determine the proportionate costs of passenger and freight tonnage, and the relative damage to track per ton of engine and cars. Also, that one member should have been assigned to the study of the locomotive superheater so as t provide suitable corrections for tables 2 and 4 on pp. 429 and 431 of the Manual.

Last year the attempt was made to divide the expense of maintenance between passenger and freight tonnage, using a multiple (two) for passenger tons. Because this multiple was rejected by the Association as not proven does not minimize the importance of securing information on the subject. As to the necessity for some such apportionment of expense, we may quote the United States Supreme Court decision in the Minnesota rate case as follows (see RAILWAY AGE GAZETTE, June 20, 1913, page 1541):

"There should be assigned to each business that proportion of the total value of the property which will correspond to the extent of its employment in that business. It is said that this is extremely difficult; in particular, because of the necessity for making a division between the passenger and freight business, and the obvious lack of correspondence between ton-miles and passenger-miles. It does not appear, however, that these are the only units available for such a division; and it would seem that, after assigning to the passenger and freight departments respectively, the property exclusively used in each, comparable use-units might be found which would afford the basis for a reasonable division with respect to property used in common."

The question of damage to track of some of the present high locomotives is also a very live one.

We do not, therefore, concur in the report of the chairman and other members; and recommend that for the ensuing year investigations be continued along the lines indicated in 1913, "report to determine the relative expense of maintenance due to passenger, freight and engine tonnage;" and that circulars "A" and "B," prepared by the former chairman, be sent out for securing the desired information.

Respectfully submitted,

C. P. HOWARD,
Consulting Engineer.
E. C. SCHMIDT,
University of Illinois.

Discussion on Economics of Railway Location.

C. P. Howard, Vice-chairman, read the majority and minority report.

(The report of the committee was accepted as a progress report.)

RECORDS AND ACCOUNTS

The Board of Direction assigned the following work for the current year:

(1) Make a comprehensive study of the forms in the Manual, which were adopted a number of years ago, and bring forms up to date.

(2) Continue the study of the economical management of store supplies.

(3) Recommend feasible and useful sub-divisions of Interstate Commission Classification Account No. 6, with a view to securing uniformity of labor costs.

(4) Study the subject of reports required by National and State Railway Commissions.

REVISION OF MANUAL.

The following conclusions are submitted for adoption:

(1) Eliminate the Foreman's Diary (form M. W. 1101), for the reason that the information given on the form should be shown on the Time Rolls (forms M. W. 1104, 1105), a space in each being provided for the purpose.

(2) Amend heading of form M. W. 701, Bridge Depart-

ment Tool Report, to read, "Maintenance of Way Department Tool Report."

(3) Form M. W. 2100 "Estimate for Track," to be made uniform with form M. W. 2201, "Estimate for Buildings, Bridges, and Water Service," by revising form M. W. 2100 accordingly.

The forms pertaining to accounts might be changed somewhat, but the committee is of the opinion that no changes made at this time would bring about a more general use of the blanks by railways, and furthermore, it seems to the committee that the rules and regulations of the Interstate Commerce Commission and of the American Railway Accounting Officers' Association have virtually disposed of the subject, and removed it from the province of the American Railway Engineering Association. It is therefore recommended by the committee that no changes be made in the forms for keeping accounts at this time so far as they appertain to the Maintenance of Way department and that the future work of the committee be confined to working jointly with committees of other associations, with the ultimate object of developing a series of forms and reports for the maintenance of way accounting system that would conform to the rulings and regulations of the Interstate Commerce Commission and be generally used by railways.

Conventional Signs or Symbols.

In the Specifications for Maps and Profiles, prescribed by the Interstate Commerce Commission, to be furnished by

W. A. CHRISTIAN,
Chairman Committee on Records and Accounts.

railway companies under the Act of Congress providing for the physical valuation of railway properties, the Conventional Signs or Symbols of the American Railway Engineering Association have been specified to be used as far as they are applicable. To make these Conventional Signs or Symbols as complete and consistent as possible, the committee carefully revised those now in the Manual and submitted a revision of the symbols for approval.

ECONOMICAL MANAGEMENT OF STORE SUPPLIES.

The committee, after careful study of the report made last year, which was received as information, has no additional recommendations to make, and resubmits the conclusions presented last year for adoption:

Conclusions.

(1) CLASSIFICATION OF MATERIAL.—It is recommended that the details of classification should conform to those adopted by the Railway Storekeepers' Association.

(2) STOCK ACCOUNT.—The conclusion reached last year is fundamental. The detailed methods of keeping the accounts may be varied to fit the individual condition. Stock accounts can be kept, (a) by ledger account; (b) by card system; (c) by personal inspection and estimation.

(3) ORGANIZATION.—The essential elements are as follows:

(a) Location.—The store should be located as closely as possible to the point of greatest consumption, so that the minimum force will be required, and the delay to material between the store and its destination may be reduced to a minimum. Usually this is at a point where equipment is maintained.

(b) Force.—The force required is dependent almost entirely on the character and volume of material issued and on local conditions. As the prompt and efficient handling of material and tools has a vital effect on the economical operation and maintenance of the railway, the force in the storeroom should be large enough to bring about this result.

(c) Position of Organization.—The consumption of supplies being greatest in maintenance of way and equipment, the storekeeper should be closely associated with the heads of these departments. It is the opinion of the committee that this can best be accomplished by having the storekeeper, engineer maintenance of way and the master mechanic report to the same officer. In a divisional organization this would place the division storekeeper under the Superintendent, and the general storekeeper under the general manager or vice-president in charge of operation.

(d) Mechanical Equipment.—The cost of unloading, storing and loading material depends solely upon the volume of business done by each store, and such appliances as will reduce this cost to a minimum are recommended.

SUB-DIVISIONS OF I. C. C. CLASSIFICATION ACCOUNT NO. 6.

In their Classification of Operating Expenses, effective July 1, 1907, and supplements thereto, the Interstate Commerce Commission includes primary account No. 6—Roadway and Track—in the maintenance of way accounts. This account includes about one-third of the total charges for material and labor in the maintenance of way and structures accounts, and includes practically all of the labor performed by section and extra gangs chargeable to the maintenance of way and structures operating expenses; it seems therefore desirable to provide sub-divisions of this primary account in order to analyze operating expenses and assist in securing uniformity of labor costs.

The Interstate Commerce Commission does not specify the number of sub-divisions of this account, provided the account is charged with all elements of expense that the classification indicates should be charged to it. Accordingly, any subdivision made would be purely a company matter.

The Interstate Commerce Commission does not specify as to the number of sub-divisions of this account, provided it is charged with all elements of expense that the classification requires. Accordingly, any sub-division made would be purely a company matter. We conclude that the sub-division is for the use of the officer in charge of the maintenance of roadway and structures, in order that he may determine the efficiency of section gangs; analyze expenses, and effect economies.

By reference to the report of the committee, contained in Vol. 14, pp. 1015-1017, it will be noted that this account is divided into nine sub-divisions, corresponding to the headings of the 13 divisions of the Interstate Commerce Commission classification. The Interstate Commerce Commission's 13 divisions were condensed to nine, and the committee does not consider the number can be still further reduced, but suggests an additional one, No. "J," the heading to be "Work-Train Service;" i. e., rather than attempt to divide the work-train service between nine sub-divisions, it would be preferable to include it as one sub-division. The total of all sub-divisions should agree with the total charged to maintenance of way and structures account No. 6, including work-train service.

We would then have ten sub-divisions as follows:

(A) Track maintenance;
(B) Applying track material;
(C) Cutting weeds and general cleaning;
(D) Ditching and bank widening;
(E) Changing grades and alinement;
(F) Flood damage;
(G) Bank protection;
(H) Filling;
(I) Other care of roadway and track;
(J) Work-train service.

The application of the sub-divisions mentioned above to the 13 divisions of the Interstate Commerce Commission classification, would be as follows:

Roadway and Track.

No. 1. Applying Ballast. Pay of employes engaged in preparing roadbed for the reception of ballast; also pay of employes engaged in applying ballast after it has been prepared and unloaded.

No. 2. Applying Ties. Pay of employes engaged in unloading, distributing and renewing cross-, switch- and bridge-ties, head-blocks and railway crossing timbers, respacing ties and burning old ties. (Classify "respacing of ties" under "A.")

No. 3. Applying Rails. Pay of employes engaged in unloading, distributing, cutting, slotting, drilling and laying rails, adzing for new rails, gathering and loading old rails and adjusting, expansion and contraction. (Classify "adjusting, expansion and contraction" under "A.")

No. 4. Applying Other Track Material. Pay of employes engaged in applying rail braces, angle bars, rail joints, track bolts and spikes, nutlocks, anti-creepers, switches, switch-stands, frogs, crossing frogs, tie plates, tie plugs and other miscellaneous track material not specified above.

No. 5. Track Maintenance. Pay of employes engaged in aligning, surfacing and gaging tracks, placing and removing track shims and tightening bolts and spikes in tracks. When a track is taken up, the labor expended therefor should be charged to this account, whether another track is laid to replace it or not.

No. 6. Care of Roadbed. Expenses of constructing and cleaning tile and open ditches; cost and expenses of placing and cleaning sewer pipes for drains (cost of sewer pipes laid under tracks should be charged to account "Bridges, Trestles and Culverts"); cost of material used and labor expended in sloping cuts, blasting rock, widening roadbeds, cuts, fills and embankments, filling borrow pits, removing slides, dangerous rocks and other similar obstructions; expenses of operating steam shovels, scrapers and ditchers while engaged in such work; also expenses of keeping tracks clear and repairing the sub-grade of tracks in cases of freshets or washouts and cost of boarding employes so engaged. Cost of labor building temporary tracks around slides and washouts and removing such tracks; cost of replacing rails, ties and ballast and repairing other damages caused by washouts to tracks proper or to the roadbed; cost of cutting, handling and placing sod; also landscape gardening and beautifying along roadway (except when chargeable to account "Buildings, Fixtures and Grounds").

No. 7. General Cleaning. Pay of employes engaged in mowing right-of-way and burning grass and weeds; cost of operating weed burners, removing brush, grass and drift from right-of-way, and removing cinders dumped by passing trains, plowing fire-guards, removing weeds from the dressing ballast, cutting sod lines, removing dirt from track yards, cleaning streets used as roadways, and loading and handling track scrap.

No. 8. Patrolling and Watching. Pay of trackwalkers, track watchmen, patrolmen, employes while extinguishing fires on right-of-way and adjacent property, and watchmen at bad spots in tracks, slides and dangerous places. (For pay of bridge watchmen, see account, "Bridges, Trestles and Culverts;" for pay of street-crossing watchmen, see account, "Crossing Flagmen and Gatemen," and for pay of tunnel watchmen, see acount, "Tunnels.")

No. 9. Changing Alinement and Grades. The proportion chargeable to operating expenses of cost of material used and labor expended in changing the alinement and reducing grades.

No. 10. Bank Protection. Cost of material used and labor expended in protecting banks by retaining walls, riprap, piling, piers, dikes or other means, and in constructing breakwaters and revetments and diverting the channels of streams to prevent cutting, washing or sliding of embankments.

No. 11. Filling. Cost of material used and labor expended in filling bridges, trestles, culverts and cattle pits.

No. 12. Other Expenses. Cost of material used and labor expended in paving and improving streets used as roadway, and oiling roadbed; payments of assessments for street repairs, sewers, or other public improvements affecting roadway adjacent thereto, not chargeable to account "Buildings, Fixtures and Grounds"; expenses incident to track inspection, premiums in connection therewith, and any other roadway or track expenses not provided for elsewhere.

No. 13. Train Service. Pay of work-train, enginemen, trainmen and enginehousemen; cost of fuel, stores and other supplies (including cost of lubricating the equipment) for work-train locomotives and cars; cost of oil and wicking used in lanterns of work-train by enginemen and trainmen, while such employes and equipment are engaged in work pertaining to roadway and track.

The numbers on the left are numbers of the Interstate Commerce Commission sub-divisions; the letters on the right indicate sub-divisions under which the whole or portions of the Interstate Commerce Commission sub-divisions are classified.

REPORTS REQUIRED BY FEDERAL AND STATE RAILWAY COMMISSIONS.

In the study of reports required by Federal and State Railway Commissions, the committee received from Canada and most of the states, blank forms on which steam railroads are required to report annually to the various Federal and State Commissions. Twenty-nine states and Canada use a form similar to that of the Interstate Commerce Commission. Ten states use different forms, but a comparison shows that they cover the same information called for in the Interstate Commerce Commission blanks. Arkansas, Arizona, Delaware, Maine, North and South Carolina, Texas, Utah, New Mexico failed to reply to the committee's request for blanks.

After careful study of the blanks prescribed by Federal and State Railway Commissions, the committee reports progress and asks an expression of views and interpretation of the subject assigned, namely, "Study the subject of reports required by national and state railway commissions"—whether it implies recommending changes in the forms prescribed by Federal and state railway commissions, or merely to make information available with reference to reports required by public service bodies.

W. A. Christian (C. G. W.), chairman; M. C. Byers (G. N.), vice-chairman; W. S. Danes (Wabash), G. J. Graves (A. T. & S. F.), G. D. Hill (I. C.), Henry Lehn (N. Y. C. & H. R.), J. H. Milburn (B. & O.), O. K. Morgan (C. C. & O.), Frank Ringer (M. K. & T.), Guy Scott (P. L. W.), Committee.

Discussion on Records and Accounts.

W. A. Christian, the chairman, presented the report.

(On motion, conclusions 1, 2 and 3 were adopted in order.)

Mr. Christian: The committee has received from the I. C. C. the symbols that they have drawn up for maps and profiles and we have embodied these in the proposed changes.

Mr. Jenkins: In view of the necessity of reproducing a great many maps for use by the Government for final records, it is essential, I think, to abandon the color scheme as far as possible. A great many of these features are such as will appear on the ordinary maps, and will have to be reproduced by photographic processes. There will be no confusion if those symbols are shown in black instead of blue, except those for canals and ditches, for which we could devise some other symbol. In view of the necessity of having these symbols adopted immediately, I would move that the committee take note of all the suggestions and changes made at this meeting, and that the committee be empowered to amend their recommended symbols as they may see fit, and that the amended symbols be considered adopted and authorized to be published in the Manual.

(The motion was carried.)

Mr. Christian: The subject of "Economical management of store supplies" was taken up by the committee last year in joint session with the General Storekeeper's Association and the conclusions arrived at were submitted as information to the Association. The committee moves that conclusions 1, 2 and 3 be adopted and published in the Manual.

L. C. Fritch: It would seem to me that a matter of that kind would be better if received as information instead of being published in the Manual. It is likely to be subject to continual change, and it seems to me it is just as valuable to us if it is a matter of information only.

The President: The committee states that they will be agreeable to that course.

Mr. Christian then read the matter under "Subdivisions of I. C. C. Classification, Account No. 6."

Henry Lehn (N. Y. C.): In view of the fact that the Division of Statistics of the I. C. C. are considering a new operating expense classification which they propose to issue at the first of the year, I move that this matter be referred back to the committee for further consideration.

(The motion was carried.)

Mr. Christian read the matter headed "Reports required by Federal and State Railway Commissions," which was accepted as a report of progress.

UNIFORM GENERAL CONTRACT FORMS

We were instructed to continue the study of the contract form and to prepare forms of proposal blanks and for bonds. The committee has received only two criticisms of the "Contract Form" adopted at the annual meeting in March, 1913, although we understand that the form has been put in use by a number of companies. One suggestion, received from the Mobile & Ohio, the committee felt could be cared for by a minor change in the form of printing, and arrangements were made with the Secretary for this change when additional copies of the contract are printed. The Toledo & Ohio Central suggested a change in clause 15, "Indemnity," and the committee wish to recommend the insertion of the words "losses and" in line 1, clause 15, after the word "against," making this clause read, "The Contractor shall indemnify and

save harmless the Company from and against all losses and all claims, demands, etc."

The committee presents herewith a form for proposals and recommends its adoption.

The committee has been unable to complete the form for "Construction Bond," and would therefore recommend that it be instructed to complete this form and furnish a copy to the Secretary. We would recommend that the Secretary be instructed to send this form to the senior officer of each road represented in the Association with a request that the Legal Departments of those roads criticize the form.

W. G. Atwood, Chairman (Interstate Commerce Commission); C. A. Wilson, vice-chairman (Cons. Engr.); C. Frank

W. G. ATWOOD,
Chairman Committee on Uniform General Contract Forms.

Allen (Mass. Inst. of Tech.), John P. Congdon (Cons. Engr.), Thos. Earle (Penn. Steel Co.), J. C. Irwin (B. & A.), R. G. Kenly (M. & St. L.), E. H. Lee (C. & W. I.), C. A. Paquette, (C. C. C. & St. L.), H. C. Phillips (A. T. & S. F.), J. H. Roach (L. S. & M. S.), H. A. Woods (G. T. P.), Committee.

FORM OF PROPOSAL.

....., 191.

.....the undersigned propose to furnish all the materials, superintendence, labor, equipment and transportation, except as otherwise specified, and to execute, construct and finish in an expeditious, substantial and workmanlike manner, to the satisfaction and acceptance of the Chief Engineer.....

.....

.....

and agree to commence the work within.....days after receipt of the notice of award of the contract, and to complete the work within.....days thereafter, in accordance with the terms, conditions, requirements and specifications covered by the request for prosposals made by .....dated .....

.....for the following prices:

.....

.....

.....

(Signed).....

Discussion on Uniform General Contract Forms.

C. A. Wilson, Vice-Chairman, presented the report.

Mr. Storey: I do not believe we will get any satisfactory construction bond, if this matter is referred to each railroad, by the end of next year. I feel that each road has to take care of its own bond and the legal department will furnish such bond as may be necessary. I do not think there is anything further in the work of this committee which pertains to this Association.

The committee was excused with the thanks of the Association.

BALLAST

The following subjects were assigned for investigation:

(1) Further investigation of proper depth of ballast of various kinds to insure uniform distribution of loads on roadway, conferring with the committee on Roadway.

(2) Revise ballast sections, with particular reference to the use of a sub- and top-ballast.

(3) Investigate methods of cleaning stone ballast and obtain cost of same by various methods.

BALLAST SECTIONS, WITH PARTICULAR REFERENCE TO THE USE OF SUB- AND TOP-BALLAST.

Your committee considered plans of ballast sections of various railroads and results of tests reported to the Association by the committee on Ballast.

There was much discussion in the committee meeting in regard to the various dimensions of the proposed ballast sections, and the committee finally came to fairly definite conclusions as follows:

(a) In Class A stone ballast section, the top-ballast shall consist of broken stone, and, where economical, there shall be a sub-ballast of fine material, such as cinders, gravel, or granulated slag.

(b) The depth of ballast shall be 24 in., and on curves the depth of 24 in. shall be maintained under the low rail.

(c) Where top- and sub-ballast is used, the thickness of the top or coarser ballast shall be 12 in. and the thickness of the sub-ballast, or finer material, shall be 12 in.

(d) The slope of the ballast on the side shall be 2 to 1, and the upper corner shall be rounded off with a 4-ft. radius.

(e) The top of the ballast shall slope with a grade of ½-in. to 1 ft., from a point in the center of the track at the top of the tie to the intersection with the 4-ft. radius above-mentioned, to avoid interference with track circuits.

(f) In a general way the proposed plan of the Baltimore & Ohio should be followed.

(g) The top of the sub-grade shall not be level, but shall be raised in the center to provide drainage.

Appendix C—proposed Class A ballast section—is in a general way the same as the proposed ballast sections of the Baltimore & Ohio Railroad.

The committee offered to the Association for favorable consideration the proposed ballast section shown in Appendix C with 24 in. of ballast under the tie, using a top-ballast of broken stone and a sub-ballast of finer material, such as gravel. The committee called particular attention to the fact that the sub-grade is wider from the center line to the outer edge on the outside of curves than it is on the inside, which appears to be the most economical method of providing for the slope of 24 in. of ballast.

The committee recommends that these ballast sections be put in service for short stretches on some railroad during the early part of 1914, and full report of process of applying

H. E. HALE,
Chairman Committee on Ballast.

and results of maintenance of same be made to the Association with final conclusions, if possible, in the 1915 report.

METHODS OF CLEANING STONE BALLAST AND COST OF SAME BY VARIOUS METHODS.

The Pennsylvania Railroad has made tests on two divisions the past year, under the following instructions:

"Select two stretches of double track one-half mile in length, one on the Pittsburgh and one on the Eastern division, which are ballasted with stone to the full section, but in which the ballast is choked with cinders or mud, and which requires cleaning.

"Clean the ballast in these stretches of track in the usual manner by shaking the ballast on forks, throwing the clean ballast retained on the forks back into the track and the small particles of ballast and dirt which pass between the tines of the forks into piles, being careful to see that none of it is lost. While this is being done, be careful to see that the track is not raised during the cleaning operation. The space between the ties should be cleaned to the base of the ties and the shoulders outside of the ties, and the space between tracks to 12 in. below the base of the ties.

"After this work shall have been completed, fill in the track to the full section, making note of the number of cubic yards of new ballast required. From the length of track cleaned and the number of cubic yards of new ballast required to fill in the track to full section after cleaning the old ballast, calculate the number of cubic yards lost per mile of double track by cleaning.

"Then pass the dirt which passes between the tines of the forks over a screen having a ¾-in. mesh and measure the number of cubic yards of small particles of stone reclaimed. From this calculate the number of cubic yards of ballast lost per mile as a result of the existing imperfect method of cleaning."

Letter reports were made, showing the results of these tests:

"We have had a test made to determine the amount of ballast lost in cleaning one mile of double track. This test was made on one-half mile of double track located between milepost 144-3300 and milepost 145-660, near Shreve, Ohio, Eastern division.

"This work was done in the usual manner, with ballast forks, and the dirt was thrown onto piles. The space between the ties was cleaned to the bottom of the ties, and the shoulders outside the track and the space between the tracks to a depth of 12 in. below the base of the ties. The dirt was screened over a ¾-in. mesh screen. The stone reclaimed by cleaning was 10 cu. yds. The track was then filled to its full ballast section with new ballast. This required 285 cu. yds. of new ballast.

"The cost of labor for cleaning this one-half mile of double track was $537.30. The cost of screening 10 cu. yds. of stone out of the dirt was $159.10. No lift was made in the tracks. From the above, we calculate the cost of cleaning the ballast on one mile of double track to be $1,074.60, the cost of screening the stone out of the dirt to be $318.20, and the number of cubic yards lost in screening to be 570. . . . .

"We have completed the experiment outlined in the instructions by cleaning the stone ballast in one-half mile of double track on a stretch beginning at the east end of No. 5 tunnel and extending eastwardly for one-half mile, where the ballast was choked with cinders and mud, with the following results for one-half mile of double track:

New ballast required after cleaning old ballast ..... 163 cu. yds.
Ballast lost per one-half mile of double track by cleaning..... 75 cu. yds.

"From the figures shown above we calculate that there would be 326 cu. yds. of ballast lost per mile of double track by ordinary cleaning and that by using a ¾-in. mesh screen 150 cu. yds. per mile could be saved. However, this seems to be a very expensive way of cleaning ballast.

"It might be of interest to know what this work cost, which is as follows:

Cleaning ballast out of track and forking it back into track	$1,062.00
Screening ballast	105.00
Leveling ballast	64.00
Loading the screenings which did not pass through ¾-in. mesh	28.00
Unloading screenings	32.00
Unloading stone ballast to fill in	11.00
Total	$1,302.00

"From this it will be noted that to reclaim 75 cu. yds. of stone on one-half mile of double track we expended $165.

"It would not have been necessary to have expended the $28 to load the screenings and the $32 to unload them, had we not been required to take accurate measurements to determine the amount of ballast saved by screening, therefore the cost of screening ballast was $105 to reclaim 75 cu. yds."

In addition to this test the following information was obtained in response to circular letter sent to railroads using stone ballast:

W. J. Backes, Engineer Maintenance of Way, New York, New Haven & Hartford Railroad: "Relative to cleaning ballast, we have cleaned some ballast on our New York and Shore Line Division. The work is done as follows:

"When renewing ties, a shovel is used to remove the ballast from track, in preparation to taking out the old ties. After the new ties are installed, stone is forked back into the track, the dirt being left in the middle gages. The dirt is then picked up by work train in the cuts and generally on the fills, and is cast or carried out in boxes and used for widening out embankments.

"We have no ballast cleaning organization, nor have we made any comparative tests of various methods. We find that it costs about $2,500 per mile of four tracks to do this work where the tracks have not been previously cleaned by sectionmen, and the dirt left in the middle gages."

The following table shows a comparison of cost of cleaning ballast on several roads and by different methods. It will be seen that the costs vary widely, due to the various methods employed and the various depths to which ballast was cleaned.

Tests on the Baltimore & Ohio have shown that ballast can be cleaned by use of screens for just one-half the cost of doing the work with forks, and that the results are more uniform and altogether more satisfactory:

Railroad.	Method of Cleaning.	Cost Per Mile, Double Track.	Remarks.
Pennsylvania.... (Eastern Div.)	Forks. (Screened dirt.)	$1,074.60	Space between ties cleaned to bottom of ties. The shoulders outside the track and space between tracks to a depth of 12 in. below base of ties. Ten yds. of stone reclaimed by screening from dirt obtained by forking one-half mile double track at cost of $159.
Pennsylvania.... (Pittsburg Div.)	Forks. (Screened dirt.)	$2,252.00	Section cleaned same as above. Seventy-five yds of stone reclaimed by screening from dirt obtained by forking one-half mile of double track at cost of $165.
N. Y. N. H. & H.	Forks.	$2,500.00 (Four tracks.)	
C. R. R. of N. J..	Forks.	$1,484.00-$2,534.40 $3,115.20 (Four tracks.)	Estimated that from 150 to 300 yds. of ballast is lost per mile of track when cleaned at intervals of three years.
N. Y. C. & H. R..	Forks.	$491.04 (Single track.) Under and between ties to a depth of 6 in.	Material removed consists largely of dirt; averages about 30 per cent.
		$813.12 (Single track.) In space between ties, track 12 ft. centers.	On four-track territory. Waste divided as follows: 16 per cent. stone could not pass through 1-in. mesh; 24 per cent. stone passed through 1-in. mesh, but was retained on ¼-in. mesh; 60 per cent. dirt passed through ¼-in. mesh.
B. & O.....	Screens.	$622.00	Cleaning and dressing. Cleaned to 12 in. below bottom of tie at berm. Cleaned to bottom of tie between ties. Cleaned to 6 in. below bottom of tie in center ditch.
		$576.00	Cleaning only. Same depth.
		$262.00	Cleaning center ditch and berm only.
		$363.00	Cleaning 6 in. below tie in center ditch and to bottom of tie between ties on each adjacent track.
		$145.00	Cleaning ditch only.

It has been found on the Baltimore & Ohio that by cleaning by screens to a depth of 12 in. below the ties on the berm, 6 in. below the ties in the center ditch, and to the bottom of the ties between ties, that there is a loss of 12.5 per cent. of the stone actually screened, or 5.1 per cent. of all stone in the track.

CONCLUSIONS.

(1) The committee recommends the following changes and additions to the Manual:

(a) Under "Cleaning Foul Ballast," change "Clean with ballast forks," to read, "Clean with ballast forks or screens."

(b) Change "Clean center ditch of double track to subgrade," to read, "Clean space between tracks to depth of 6 in. or more below the bottom of ties."

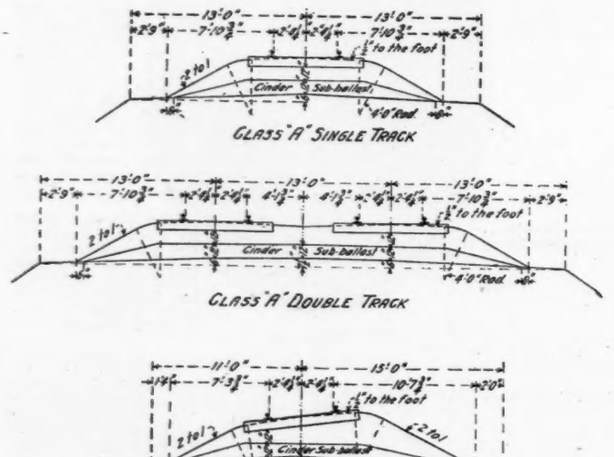
(c) Add, "Clean the berm to bottom of ballast, preferably not less than 12 in."

(d) Add, "Clean cross-ditches between ties approximately every rail length, or 33 ft. Cross ditches should not be under rail joints."

(e) Add, "Tests fully described in the report of committee on Ballast for 1914 indicate stone ballast can be cleaned by use of screens for approximately one-half cost of cleaning stone ballast with forks.

PROPER DEPTH OF BALLAST OF VARIOUS KINDS TO INSURE UNIFORM DISTRIBUTION OF LOADS ON THE ROADWAY.

On April 15, 1913, this question was taken up by the committee on Ballast with President Wendt, with a view of financing the test recommended, by the committee on Ballast



Proposed Ballast Sections.

in the annual report of 1913, and the following schemes were proposed:

(a) W. M. Dawley, chairman of the Roadway Committee, proposed to combine this test with the Roadway Committee's test "to determine the stresses in track," which is to be financed by the United States Steel Corporation and others.

(b) President Wendt endeavored to obtain financial assistance from the American Society Civil Engineers.

However, the efforts to make the test recommended by the committee on Ballast above-mentioned, failed and to date no method has been arranged for by which this test can be financed.

For ready reference, the following is a copy of test recommended in 1913, and an estimate of cost. This estimate is probably high, and was intentionally made so. It is believed that by careful handling the test can be made for much less money than the following estimate, as any railroad which is purchasing stone ballast could easily afford to disregard the item of $400 for stone ballast:

"(1) Select a stretch of track on clay roadbed, under heavy traffic, where trouble has been experienced with clay working up betwen the ties.

"(2) Excavate the roadbed to a uniform depth of 30 in. below the bottom of the ties, for a space of two rail-lengths; prepare the adjacent rail-lengths in the same manner, decreasing the depth 3 in. under each successive two rails, until the bed is 12 in. below the bottom of the tie (14 rail-lengths).

"(3) Place on this bed a thin layer of fibrous material, such as hay, to make a well-defined separation between the roadbed and ballast.

"(4) Place stone ballast on the bed to the above-mentioned depths, tamp well, and put the track in good line and surface.

"(5) Make note of tie-spacing, width of ties, keep accurate levels, and record of amount of time spent on surfacing various parts of track, also keep record of axleloads and amount of traffic. Take photographs at regular intervals to show deformation of roadbed.

"(6) Make similar tests for gravel and for ballast section, having a sub-ballast of gravel equal to one-half the total depth and a top ballast of stone equal to one-half the total depth of ballast.

"(7) The estimated cost of this test is as follows:

(a)	Cost of material (stone), 500 yds. at 80 cents	$ 400
(b)	Labor, preparing track and widening bank, where necessary, at $30 per rail (14 rails per test)	420
(c)	Labor, inspecting, six inspections at $2 per rail	170
(d)	Line and surface to be paid for by railway owning track, at regular maintenance charge	...
	Total for one test	$ 990
	Three tests	$3,000

In view of the dearth of authoritative information on this subject and the fact that all experiments to date have been made under artificial conditions, your committee feels if further reliable information is to be procured that a further test must be made.

H. E. Hale (M. P.), chairman; J. M. Meade (A. T. & S. F.), vice-chairman; L. W. Baldwin (I. C.), D. P. Beach (P. L. W.), W. J. Bergen (N. Y. C. & St. L.), A. F. Blaess (I. C.), T. C. Burpee (Intercolonial), O. H. Crittenden (I. & G. N.), F. T. Darrow (C. B. & Q.), J. M. Egan (I. C.), T. W. Fatherson (C. R. I. & P.), H. L. Gordon (B. & O.), G. H. Harris (A. T. & S. F.), C. C. Hill (M. C.), S. A. Jordan (B. & O.), William McNab (G. T.), A. S. More, J. V. Neubert (N. Y. C. & H. R.), S. B. Rice (R. F. & P.), E. V. Smith (B. & O.), F. J. Stimson (G. R. & I.), S. N. Williams (Cornell College), Committee.

Discussion on Ballast.

H. E. Hale, chairman, presented the report.

W. L. Morse (Jacksonville Terminal): I think there are very few roads in the country that can possibly have class A tracks if class A tracks require a ballast of this section. We do pretty well if we can get 10 or 12 in. While this may be ideal, I think the committee report should be based on what the majority of the roads of the country can possibly use. I doubt if there is a road that has 50 miles of track that has as much ballast in it as standard as the committee has recommended. I think the committee should recommend something that is practicable.

Mr. Hale: The committee felt that there are many places where 12 in. is not enough. It is not supposed that every railroad in the United States will put 24 in. under the ties, but we do know some roads that are doing it. On page 963 is shown a photograph of what is being done on the Pennsylvania. The report also shows what is being done on the B. & O. The tendency is to go to a ballast section of over 12 in. The committee submits this as its idea of what would be first class.

L. C. Fritch: I think the committee is working along right lines. We all know, with the dense traffic to-day, with the heavy wheel loads, we do not have sufficient ballast under the ties to maintain the track. The committee should be slow, however, in making recommendations in this matter until exhaustive tests have been made, which the special committee on track stresses will undertake. There have been some valuable tests made on the Pennsylvania which demonstrated with certain densities of traffic and wheel loads at least 24 in. of ballast is necessary to maintain the track.

F. L. Stuart (B. & O.): We have on our road one point where we are preparing our cuts and fills for 2 ft. of ballast under the track. When we first lay our rails we will probably put in 18 in. of ballast, and then leave the other 6 in. for the track force to raise in the course of their work. We do not suggest that section for all the roads in the country. However, the foundation of all good track is ballast, and the more ballast you get under the ties, the better returns you will get, if you keep

within certain limits. I think, however, it is an injustice to some railroads in the country to recommend 2 ft. of ballast for class A tracks. Twelve in. of ballast will make a satisfactory track for class A operation, and 24 in. is only required for exceptional conditions.

J. B. Berry (C., R. I. & P.): Your new committee on track stresses is to be given $10,000 by some of the steel companies, and they expect to get $2,000 from the American Society of Civil Engineers. The committee held a meeting yesterday and will organize for work in the near future. Among the things the committee will follow up is the question of the amount of ballast under the tie. I think this committee on ballast can safely wait until they hear from this new committee before they ask for any appropriation, as it is the intention of the Committee on Track Stresses to investigate the matter very thoroughly, and they hope to report to the Association next year.

YESTERDAY'S REGISTRATION—AMERICAN RAILWAY ENGINEERING ASSOCIATION

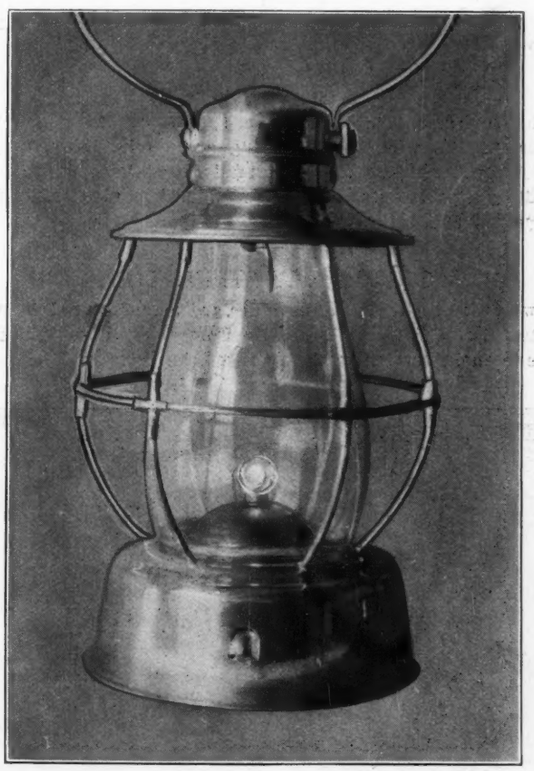
Allen, Andrews, Consulting Engr., Chicago, Ill.
Baldwin, A. S., Director, Chief Engr., I. C. R. R., Chicago, Ill.
Boughner, A. G., Asst. Engr., B. & O. R. R., Baltimore, Md.
Carter, E. M., Supr. B. and B., T. C. R. R., Nashville, Tenn.
Emerson, Raffe, Con. Engr., New York, N. Y.
Breckinridge, W. L., Engr. M. of W., C., B. & Q. R. R., Chicago, Ill.
Gibson, H. R., Div. Engr., B. & O. S. W. R. R., Flora, Ill.
Gifford, Geo. E., Secretary, Bridge Builders' Society, New York, N. Y.
Hanna, John V., Chief Engr., K. C. Ter. Ry., Kansas City, Mo.
Haskell, F. H., Asst. Engr., C. M. & St. P. Ry., Delmar Junction, Iowa.
Laas, Edward, Broadlands Hotel, Kansas City, Mo.
McCormick, R. L., Asso. Prof. C. E., Rose Poly Inst., Terre Haute, Ind.
MacPherson, Duncan, Asst. to Chairman, Nat. Trans. Ry., Ottawa, Ont.
Nye, C. M., Prin. Asst. Engr., G. N. Ry., St. Paul, Minn.
Paquette, C. A., Ch. Engr. M. W., C. C. C. & St. L. Ry., Cincinnati, Ohio.
Pelley, John, Supt., I. C. R. R., Fulton, Ky.
Pfeifer, H. J., E. M. W., Ter. R. R. Assn., St. Louis, Mo.
Purdy, W. F., Chief Engr., Wabash Pitts. Ter. Ry., Pittsburgh, Pa.
Ritter, Adam, Arch., Q. & C. Route, Cincinnati, O.
Ritter, Louis E., Consulting Engr., Chicago, Ill.
Robinson, E. F., Bridge Engr., Santa Fe Ry. System, Chcago, Ill.
Rossiter, L. P., Des Moines, Iowa.
Sarvey, A. L., Val. Engr., M. C. R. R., Detroit, Mich.
Scott, W. B. (Director), Prest. Sou. Pac. Lines, Texas and La., Houston, Tex.
Taylor, R. T., Roadmaster, Northern Pacific Railway, Dilworth, Minn.
Watson, P. J., Jr., Asst. Engr., C. & A. Ry., Bloomington, Ill.
Weaver, H. A., Div. Engr., N. Y. H. & H. R. R., Boston, Mass.
Wherry, B. T., Asst. Engr., N. P. Ry., St. Paul, Minn.
Williams, K. G., Engr. in Chg., Rock Isl.-Memphis Term. Ry., Memphis, Tenn.

GUESTS.

Alexander, V. M., Asst. to Prest., C. & A. R. R., Chicago, Ill.
Bloecher, Theo., Jr., Material Engr., B. & O. R. R., Baltimore, Md.
Bost, R. G., Res. Engr., T. & N. O. Ry., North Bay, Ont.
Boughton, N. J., Asst. to Engr. Tests, Topeka, Kas.
Bryan, Hardy, Engr., Tenn. R. R. Comm., Nashville, Tenn.
Cheatham, S., Roadmaster, M. & O. R. R., Murphysboro, Ill.
Correll, E. J., Hicksville, O.
Daley, F. J., Chief Pay Roll Insp., J. C. R. R., Homewood, Ill.
Dickens, E. S., Secty. to Prest. Notre Dame University, Notre Dame, Ind.
Drayer, E. E., Asst. Engr. Valuation Dept., N. Y. C. & St. L. Ry., Cleveland, Ohio.
Dutton, Henry P., U. of Mich., Ann Arbor, Mich.
Emmons, S. E., Asst. to Engr., C. S. B. & N. I. Ry., South Bend, Ind.
Fisher, Frank X., Transitman, C. & W. I. R. R., Chicago, Ill.
Fritch, E. H., Jr., Notre Dame, Ind.
Fritch, Leuis C., Notre Dame, Ind.
Hanly, F. F., Asst. Engr., B. & O. R. R., Baltimore, Md.
Haydock, C. L., Ast. Engr., Mo. Pac. Ry., St. Louis, Mo.
Huang, A. Y., University of Michigan, Ann Arbor, Mich.
Konns, C. W., Gen'l Mgr., A. T. & S. F. Ry., Topeka, Kan.
Leach, Frank J., University of Michigan, Ann Arbor, Mich.
Long, Jno. C., Levelman, C. & W. I. R. R., Chicago, Ill.
Marshall, H. L., Genl. Ballast Inspector, Martinsburg, W. Va.
McAlpine, A. R., Chicago, Ill.
McConnell E., Transitman, A. T. & L. Ry., Marceline, Mo.
McNay, C., Mo. Pac. R. R., St. Louis, Mo.
Miles, H. A., U. of Mich., Ann Arbor, Mich.
Moore, Jno. E., Caracas, Venezuela.
Neale, Milton M., Dunora Sou. R. R., Dunora, Pa.
Northam, M. P., Asst. Div. Engr., B. & O. R. R., St. George, S. I., N. Y.
Ong, J. R., Div. Engr. Electric Ry. Dept., R. R. Comm. of Wisconsin, Madison, Wis.
Schlinkert, F. H., Supt. Scales, Mo. Pac. Ry., St. Louis, Mo.
Schlinkert, Walter, Asst. Supt. Scales, Ill. Cent. R. R., Centralia, Ill.
Snesserolt, J. L., Asst. Engr., B. & O. R. R., Wheeling, W. Va.
Spenseller, I. S., Genl. Supervisor, B. & O. R. R., Cumberland, Md.
Terrell, G. A., U. of Mich., Ann Arbor, Mich.
Thompson, W. G., Detroit, Mich.
Weidel, Jos., Asst. Engr., P. & N. T. Ry., Lubbock, Tex.
Young, Wm., Genl. R. M., T. & N. O. Ry., North Bay, Ont.

AN ELECTRIC HAND LANTERN

An electric hand lantern is being manufactured by the American Minute Photo Company, 2216 Ogden Ave., Chicago, which has the advantages over an oil lantern that it is always ready; it requires no attention and can be used with safety in places where an oil lantern would be dangerous. The



Electric Hand Lantern.

frame is made the same in appearance as a high-grade trainman's lantern, being of solid brass, nickel-plated. The electric power is furnished by a three-cell dry battery carried in the base of the lantern connected to a 3½ volt 1½ candle power incandescent lamp. The battery is sold under a guarantee to give thirteen hours' continuous service or 28 hours intermittently. New batteries can be secured at any electrical supply store for 40 cents, and new burners cost 30 cents. The globes are standard

size, which retail for 10 cents. The control is effected by the bail. When it is in the vertical position, as in carrying, the light is on. When it is dropped on one side the light is off; when dropped on the other side the light remains on. The lantern complete weighs 2¼ lbs.

WINSLOW STRENGTH COMPUTING SLIDE RULE

A new direct-reading slide rule for solving beam problems mechanically has just been placed on the market by Henry W. Tomlinson, Chicago. It is adapted to calculate the strength of beams of any material, any size, span, spacing or load, and also takes into account the method of loading and the factor of safety. It can be used for wooden beams in sizes from 2 in. by 2 in. up to 24 in. by 30 in., of any kind of timber, either full size or dressed size. This feature adds greatly to the value of the instrument, both in accuracy and as a time saver.

Winslow Strength Computing Slide Rule.

In steel work it can be used for ¼ in. plates or 1½ in. angles up to 30 in. 200-lb. I-beams, including bars, angles, channels, I-beams and H-beams. By using the section modulus scale the strength of any section may be calculated. Spans varying from 3 ft. to 40 ft. can be used, and 60 different methods of loading are provided in the direct reading on the rule.

The instrument is made of a special grade of German silver, 3½ in. wide, 10½ in. long and $\frac{1}{16}$ in. thick, weighing 10 ounces. The rule is already used in a number of building departments, and by structural engineers, bridge companies and railways.

THE MAXEY STEEL TIE

Twelve steel ties of a new design, manufactured by the United States Steel Railway Tie Company, Pittsburgh, Pa., have been in service in the track of the Pittsburgh & Lake Erie at Glassport, Pa., since October 10, 1912. They are on an easy curve—about 1 deg. 30 min.—which carries a heavy main-line traffic. They are reported to have given good service up to date.

A Pile of Maxey Steel Ties Showing Method of Clamping on the Rails.

The tie is a steel casting, the main member being of an inverted "T" shape, with flanges on each side under the rails, the rail seats carried on these flanges giving them approximately an I-beam cross section. The tie is 6 ft. long and about 5 in. high, the bottom flange is 8 to 10 in. wide and the web ⅜ in. thick. The rail seat is 20 to 24 in. long, and the total weight of the tie is 200 to 225 lbs., depending on the length of this seat.

The rail is fastened to the tie by a clamp on the inner edge of the rail seat, the outer edge of the rail being held in a slot in the edge of the seat. The clamp is secured by two lugs, which are inserted in tapered slots, which are wedged on the lugs by striking the clamp with a hammer. The clamps are all duplicates, allowing them to be used on either rail.

A special joint is designed for use with this tie, consisting of a straight bar or fish plate on the inside of the rail and an angle bar on the outside of the rail, the latter having a notch cut in its lower edge, into which the rail seat of the tie can fit in order to make the joint serve as an anti-creeper. The shape of the clamp used to attach the rail to the tie on the inside is such that it will hold the bolt at a joint firmly in place.

THE HERCULES STEEL BUMPING POST

The Michigan Central has just installed 25 Hercules steel bumping posts in its coach yard at the new passenger terminal in Detroit, Mich. These posts have also been installed recently at the new station of the Atlantic Coast Line in Wilmington, N. C., and the new station of the Seaboard Air Line at Tampa, Fla.

These posts are made of boiler plate steel and malleable iron, enclosing six heavy steel springs in the head to form a cushion for the blow. In the Michigan Central installation concrete blocks are used against the back brace, and a tunnel is provided under the row of posts, so that the anchor rod can be easily renewed if necessary. These posts are manufactured by the Railway & Traction Supply Company, Chicago.

Hercules Bumping Posts in Michigan Central Coach Yard at Detroit.

Over seventy-seven officers and other employes of the Grand Trunk have been in attendance at the convention one or more days during the past week, this road ranking second only to the Baltimore & Ohio in point of attendance. Included in this number were two parties engaged on valuation work, who were relieved of their duties for a few days to enable them to come to Chicago at this time.